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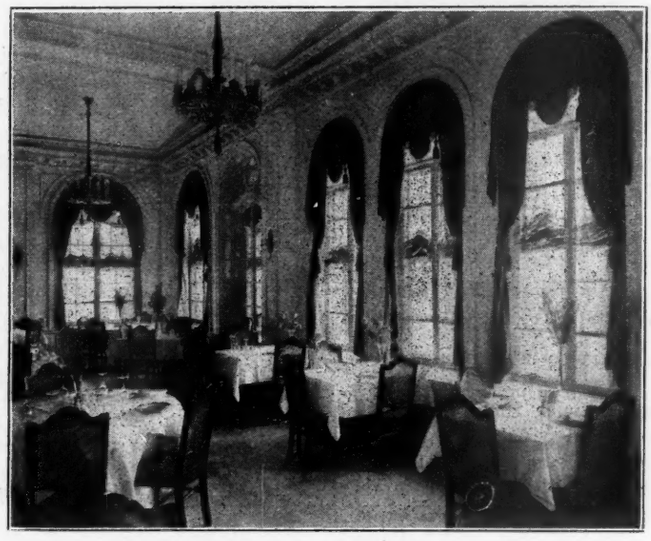
Design and Construction of Large Lighting Fixtures

Art and Principles of Engineering and Illumination Involved in Manufacture of Decorative Fixtures of Large Size—Details of Shape, Color and Illuminants Are Important Factors

The manufacture of electric lighting fixtures, like many other enterprises, may be carried on as a series of standardized processes for the production of large numbers of identical units or as a series of more or less special construction jobs. The first method of manufacture is applicable to the production of moderately priced equipment finding use among a fairly wide range of purchasers, while the second method of manufacture is suitable only for the production of equipment that appeals to the demand of a limited few. Special materials, designs, shapes, finish and trim may be used in the second method to produce fixtures and fittings that harmonize with the individual surroundings in which they will be associated or that appeal to the taste or fancy of the purchaser.

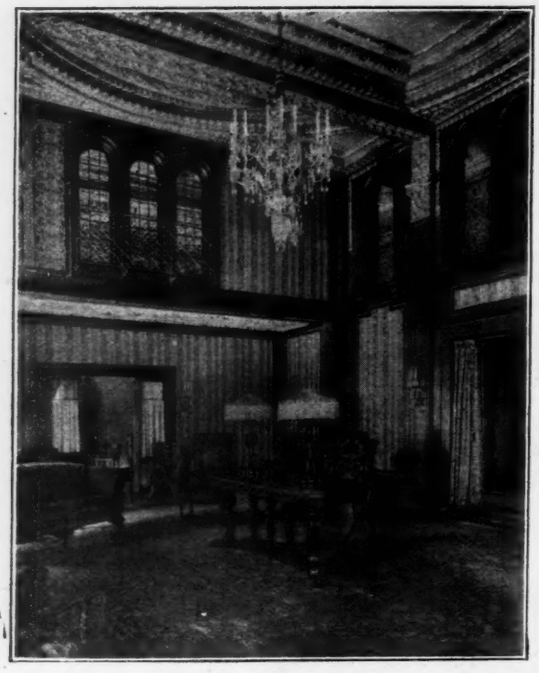


Lighting Fixture in Dining Room of Sisson Hotel, Chicago.

Hotels, theaters, club houses, churches, auditoriums and large residences must be provided with fixtures designed to harmonize with their interior finish as well as produce proper lighting effects, if pleasing and satisfactory results are to be obtained. Such fixtures cannot be purchased from stock, because stocks could never be prepared to meet the different needs without unwarranted cost and the sacrifice of many details of individualism. The great variety of combinations of architectural and decorative details employed in the interior finish of large buildings precludes the possibility of ever arranging a line of standardized fixtures that would give both satisfactory lighting and architectural effects. Thus it is evident that there is and probably always will be a wide field for the manufacture of special lighting fixtures. As a rule, the prospective owner of a new property of the type requiring special equipment is not so much interested in the detail employed as he is in the ultimate effects produced.

Selection of fixtures of the character required cannot be made from catalogs or from samples on display in showrooms, but must be made from designs, by compromise between equipment in existing installations or by delegating the task of providing the required units to some competent person or organization fitted by practice to know what is suitable for the particular service desired. It is obvious that the production of such equipment partakes fully as much of the nature of the artist's work as of the manufacturer's.

From the mechanical point of view, design and construction of the larger pieces comprises a task of no mean proportions. Fixtures weighing as much as 3000 lbs. are made at times, and sometimes as many as 300 or 400 separate sockets are mounted on a single structure. Single units have been built of such proportions that a separate flatcar was required to provide sufficient space for shipment, and special allowances had to be made for the supporting structures in the building frame. In contrast with these great units, smaller ones holding only a single socket, and often intended to serve as ornaments rather than light sources, must be provided to retain the characteristics of symmetry striven for in the production of the larger pieces. Between these two limits are fixtures of every conceivable size and shape, some intended to accomplish one result, while others will be designed to accomplish something quite different. Size, shape and coloring may be used to make the lighting equipment



Chandelier Installed in One of Chicago's Palatial North Shore Residences.

stand out as a conspicuous decorative element or to blend in as an unnoticed detail according to the desire and skill of the designer.

Typical Examples of Large Fixture Installations.

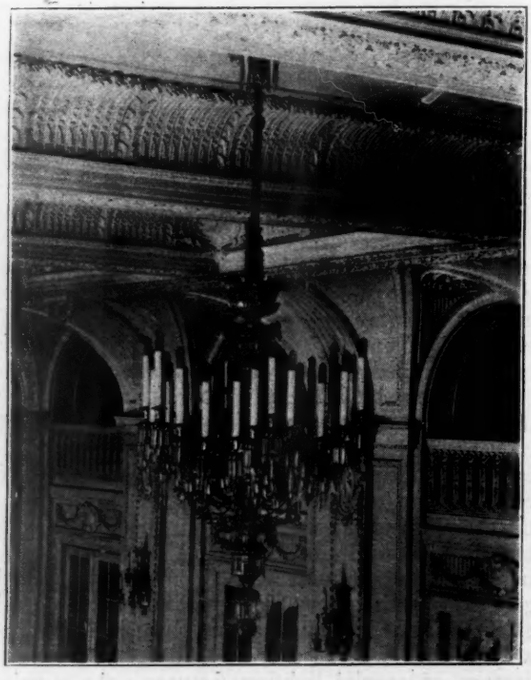
The fixtures shown in the accompanying illustration of the dining room of the Sisson Hotel are arranged to harmonize with the appearance of simplicity, and help to convey the general idea of quiet and comfort. Somewhat opposed to this idea, the chandelier in the Robidoux Hotel stands out as an individual decorative feature, while still fitting in with its surroundings and helping to convey the general impression of massiveness and splendor. Richness of detail and complete harmony with the general scheme of interior finish are to be seen in the illustration showing a large residence fixture installed in a home in the North Shore district of Chicago. The illustration showing a fixture in the process of construction serves to convey beyond a doubt the idea that such equipments as those shown are not simply an assemblage of standard parts, but are actually constructed as individual pieces. It may be noted that the piece in question was too large for the room in which it was erected, and a hole had to be cut through the ceiling to make room for the top part or head.

Molding, filing, fitting, brazing, hammering and spinning form the ground work or body structure of the fixture. Sometimes metal or composition bodies are worked into or over the main structures, and in other instances separate parts are attached by means of hooks, chains or other supporting members At the present time there is a tendency to add crystal ornaments to many of the fixtures being made for large auditoriums, these crystal ornaments being typical of certain period styles of architecture now much in favor. The metal structure, or the body if one is used, must be finished in coloring suitable to the surroundings. Paints, polychrome finishes, silver, copper and gold plating, and various other processes are used to give the intermediate and final touches of finish. Often many coats of paint are applied, one partly or completely covering another, with sometimes two or three colors remaining in a mottled pattern over a solid background in the completed job.

Both Art and Engineering Required in Fixture Manufacture.

The construction of fixtures such as these is indeed a work of both engineering and art. The structures must be strong enough, must present a pleasing appearance of themselves, and in the end must be fitted to provide illumination for the space in which they are installed. Strength without harmony or strength and harmony without good illumination would leave the finished work more or less a failure. It is only by combining all three elements that perfect satisfaction can be obtained. In order to be assured that the element of illumination is always properly cared for, some manufacturers consider this part of the problem first. The size, shape and finish of the room is considered, and the proper amount of light is determined to give the required illuminating effects. Then consideration is given as to how this light should be produced and what form should be given to the fixture. Some lighting problems call for a few large light sources, while others may call for many. Under some conditions fixtures present the best appearance when made broad and flat, and with certain other surroundings they may be round, oblong, rectangular, or tall and stately to fit in with a general plan.

In the end, illumination is the prime object of the fixture, for without the need of illumination there would be no need for the fixture itself. A set of brackets or bodies of plaster might well be used purely as ornaments without any other con-

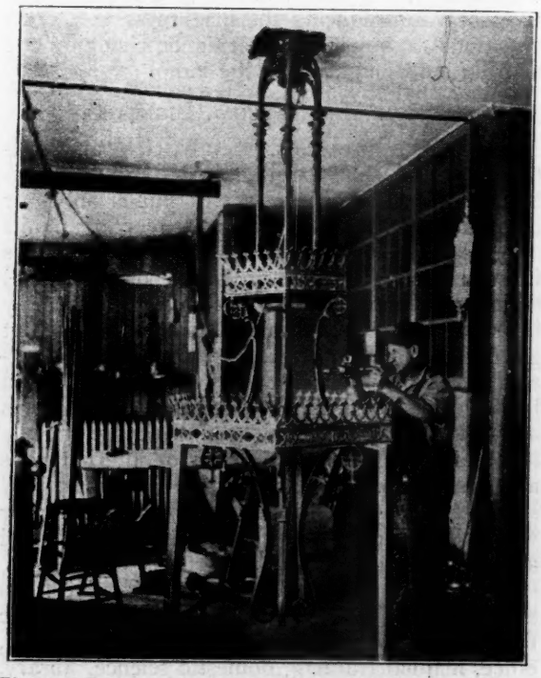


Chandelier in Ball Room of Robidoux Hotel, St. Joseph, Mo.

sideration, if good lighting was not the real purpose to be accomplished by the installation. On the other hand, if only good lighting were desired, a series of standard commercial units might be selected and installed with excellent results and at much less cost. But where light and harmony are required, consideration must be given to both, and structural details must be arranged to fit in with the lighting details in every respect. Where a fixture will be viewed sometimes by its own light and sometimes by daylight consideration must be given to its appearance under both circumstances. Where daylight is never present, consideration must be given chiefly to the appearance and effects produced when the fixture is viewed only under its own illumination and that produced by other nearby units. The mistake is sometimes made of working elaborate details into fixtures that are to be suspended and lighted in such fashion that the detail is lost in the ultimate effect. In other cases detail is avoided until plainness becomes predominant and ruins the possible impressions of an otherwise well-planned fixture.

Good Design a Matter of Balancing Various Factors.

It is by watching and weighing these various conditions and assigning each its proper consideration in design that the best results can be obtained. The designer who attains success in this field must be thoroughly grounded in all the underlying principles with which he has to deal in a material way, and in addition he must understand and know how to control the human element in order to prevent or modify the carrying out of a prospective purchaser's impractical ideas. This is often one of the most difficult parts of the entire problem and on its successful accomplishment rests the success of the designer in fully as many cases as may be attributed to any other single factor.



Fixtures Being Assembled in Plant of Victor S. Pearlman & Co., Chicago.

Loggia in Sales Rooms of Victor S. Pearlman & Co., Chicago, Showing Lighting Fixtures.

Recent developments in lamp manufacture have added greatly to the possibilities of fixture design from an illuminating point of view. With tungsten, daylight and white Mazda lamps, each with its own coloring features, the designer may select one or several types of light source to produce effects not obtainable until recent years. In fact, if proper selection of lamps is made, almost any color may be given its natural tone under artificial light. However, if this point is not given proper attention, fixtures may be produced with truly wonderful appearance by daylight, but with almost no coloring at all by their own light. Or the designer may avoid the use of colors that might add greatly to the appearance of a fixture both by day and night, if he is not well versed in the properties of the various light sources available for his use. By using various types of lamps and colors of light, by using concealed sources, or by using partly concealed and partly exposed sources an almost endless variety of effects may be produced.

INCREASE IN NUMBER OF WESTERN ELECTRIC EMPLOYES.

During September the employes on the payroll of the Western Electric Co. numbered 34,222 (the highest point in the history of the company) compared with a total of 25,360 for the same month in 1919. Of the present staff 21,626 are located at the Hawthorne (Ill.) plant, while a year ago there were only 15,358 employed there. The staff of the engineering department numbered 3512 in September of this year, or an increase of 943 over the same month in 1919. It is predicted that the production of the automatic telephone will mean further additions to the personnel of the Hawthorne plant. Several new buildings are now being erected.

Proposed School-Lighting Code for Wisconsin

Draft of Regulations to Meet Specific Requirements for Daylight Illumination in Public Schools as Well as Provide Adequate Distribution of Artifical Light and Elimination of Glare

Within recent years state organizations have given considerable attention to lighting, especially for industrial purposes, and progress in this direction has been marked by the drafting and enforcement of industrial lighting codes in a number of states. Among the first to realize the importance of good industrial lighting, from the standpoint of safety, hygiene and sanitation, was the Industrial Commission of Wisconsin. About 1912 this body drafted an industrial lighting code which has become well recognized as one of the most complete and specific codes covering the installation and maintenance of factory illumination that has been advanced by any organization. During 1919 the Wisconsin commission drew up a code covering the regulation of automobile headlights, approval of which was made this spring.

The activity of the commission in the field of lighting has again come to the fore. Realizing the necessity of correct lighting in the public schools, the commission has drafted a code of lighting for the schools of Wisconsin. It is based on the recommendations of the Illuminating Engineering Society, but is designed to be more definite with respect to requirements for natural daylight illumination and with respect to the glare and distribution of artificial light.

The code has been prepared in tentative form and has been submitted to leading illuminating engineers of the country with a request for criticisms and suggestions, which are being received by John A. Hoeveler, electrical engineer of the commission, who prepared the major portion of the tentative draft.

SECTION I.—APPLICATION AND DEFINITIONS.

Application.—This code shall apply as a minimum requirement for all new construction and reconstruction begun subsequent to its adoption.

Scope of Orders.—This code sets forth the minimum requirements for the natural and artificial lighting of all school buildings, both public and private.

Meaning of Terms.—The following definitions give the meaning of some of the terms occurring in this code; terms not defined will be understood to have their customary meanings.

(1) Candle (or candle-power) means the unit of luminous intensity maintained by the national laboratories of the United States, France and Great Britain.

(2) Lumen means the unit of luminous flux equal to the flux emitted in a unit solid angle (steradian) by a point source of unit candle-power.

(3) Foot-candle means the unit of illumination equal to 1 lumen per sq. ft. The foot-candle is the lighting effect produced upon an object by a lamp of 1 candle-power at a distance of 1 ft.; at 2 ft. the effect would be not the one-half foot-candle, but one-fourth; at 3 ft., one-ninth foot-candle, etc.

(4) Photometer means an instrument suitable for making illumination measurements.

(5) Lamp means that part of the lighting equipment from which the light originates. With electric lighting it means the incandescent lamp bulb or the arc, and with gas lighting the burner and mantle.

(6) Local lamps (or lighting) means lighting units located close to the work and intended to illuminate only a limited area about the work.

(7) Overhead lamps (or lighting) means lighting units installed above ordinary head level to secure a general illumination over a considerable area.

(8) Brightness means the intensity of light per unit area emitted from or reflected by a body; in this code it is expressed in candle-power per square inch.

(9) Glare means any brightness within the field of vision of such a character as to cause discomfort, annoyance, interference with vision or eye fatigue.

(10) Eye strain means a physiological condition of the eye resulting in discomfort, poor vision or fatigue.

(11) Shaded means that the lamp is equipped with a reflector, shade, inclosing globe or other accessory for reducing the brightness in certain directions or otherwise altering or changing the distribution of light from the lamp.

SECTION II.—NATURAL LIGHTING.

General Requirements.—Study, class and recitation rooms shall be illuminated by the unilateral (windows to the left of pupils only) or bilateral (windows to left and rear of pupils only) systems of natural lighting from windows in exterior walls only. Laboratory, office, manual training and domestic science rooms, assembly halls, auditoriums, libraries, museums and art galleries shall be illuminated by windows in exterior walls or from overhead skylights, or from both. Halls, corridors, stock and supply rooms and closets shall be illuminated by skylights or by side windows placed in exterior or interior walls and partitions. Toilets shall be illuminated by skylights or by side windows placed in exterior walls. Walls of large light courts are considered as exterior walls in this code.

Glass Area of Windows.—The effective glass area of the windows shall be at least 20% of the floor area of study, class, recitation, laboratory, office, manual training, domestic science, library, sewing, drawing and drafting rooms, and all spaces devoted to similar use. No specific glass

area requirement is made for the other rooms of school buildings, but it is recommended that generous provision be made for natural lighting, because of the value of good daylight in conserving eyesight, and because of the hygienic value of plenty of sunlight.

Height of Window Sills.—Sills of side windows shall be at least 36 ins. above the floor in the rooms and spaces listed above. A sill height of 42 ins. is recommended especially in rooms occupied by grades above the fourth.

Height of Window Heads or Tops.—Tops of windows in rooms and spaces listed above shall be carried as close to the ceiling as practicable, but in no case shall they be less than 8 ins. below the ceiling. Height of window head shall also be at least one-half the room width (measured at right angles to the glass surfaces). Where bilateral lighting is used the height of window head need be only four-tenths the room width. Where skylights are used no limitation on room width is placed.

Window Shades.—All side windows exposed to direct sunlight or bright light from the sky shall be equipped with window shades adequate for the purpose of controlling such bright light and eliminating glare.

These shades should perform several functions, namely, the diffusion of direct sunlight, the control of illumination to secure reasonable uniformity, the elimination of glare from the visible sky and the elimination of reflected glare from the blackboards. These requirements make it desirable to equip each window with two shades operated by double rollers placed near the level of the meeting rail. Shades so placed may be raised or lower from the middle, which provides elasticity for shading and diffusing the light. The material of the shade preferably should be a yellow or tan-colored material sufficiently translucent to transmit a considerable percentage of the light while at the same time diffusing it.

A more complete control of the light may be obtained by the use of two independent sets of shades at each window. The one, a translucent shade, should roll from the top down; the other a very dark heavy shade (green) should roll from the bottom upward.

Adjustable shades of a tan color meet the above requirement.

Since it is the top portions of the windows which supply the illumination to the spaces farthest from the windows, it is bad practice to shut out bright light by pulling down an opaque shade from the top, as this will make the illumination of these spaces inadequate during the hours when it would otherwise be best.

Finish of Ceilings.—Ceilings shall be finished with a matte or dull surface having a coefficient of diffuse reflection of at least 0.70.

Finish of Walls of Rooms.—Walls to top of blackboard, or to a height of 6 ft., above the floor where blackboards are not used, shall be finished with a matte or dull surface having a coefficient of reflection of at least 0.35. Below this level a darker finish may be used. Glossy surfaces cause eye strain because of the specular or mirror-like images of windows and artificial light sources in such surfaces.

Average coefficients of diffuse [illegible] of various colors measured with the light from tungsten lamps are as follows:

White paper	0.81	Tan	0.37
Ivory white	0.76	Cocoanut brown	0.22
Caen stone	0.72	Satin green	0.67
Ivory	0.72	Bright sage and ivory tan	0.47
Ivory tan	0.58	Bright sale	0.43
Primrose	0.67	Forest green	0.21
Lichen gray	0.70	Olive green	0.14
Pearl gray	0.70	Pale azure and white	0.53
Silver gray and caen stone	0.50	Pale azure	0.36
Buff stone and pale azure	0.44	Sky blue	0.31
Buff	0.59	Shell pink	0.57
Buff stone	0.51	Pink	0.51
		Cardinal	0.27

Finish of Walls of Light Courts.—Walls of light courts shall be finished with a surface having a coefficient of reflection of at least 0.50.

Section III.—Artificial Light.

General Requirement.—All rooms and spaces of school buildings shall be equipped with means for supplying artificial illumination adequate for the purpose to which each room or space is devoted.

Intensity of Artificial Illumination.—Rooms and spaces of school buildings shall be supplied with intensities of artificial illumination in accordance with the following table, the minimum permissible intensity of illumination at the work being:

Room or Space.	Foot-Candles.
Storage spaces	0.5
Stairways, corridors	1.0
Gymnasiums, auditoriums, assembly rooms, museums, art galleries	2.5
Class, study, recitation rooms and libraries	5.0
Laboratories, manual training, domestic science (except sewing)	5.0
Sewing, drawing, drafting	8.0

The above are minimum permissible intensities. Materially higher intensities are recommended for best results. Where it is desired to see objects in their daylight hues, as for art work, the use of artificial light having an average daylight spectrum is suggested.

Shading of Lamps for Overhead Lighting.—Overhead artificial light sources suspended at elevations above a level plane 4 ft. above the floor, of less than one-half their distance from any position in the room or space illuminated shall be shaded in such a manner that the intensity of the brightest square inch of visible light source does not exceed 15 candle-power. Glare from lamps or unduly bright surfaces produces eye strain, and must, therefore, be avoided. Very much lower brightness of artificial light units, than specified above, is desirable in class, study and recitation rooms. A maximum brightness not to exceed that of the sky (1.5 to 3.0 candle-power per sq. in.) is recommended.

Shading of Lamps for Local Lighting.—Local artificial light sources shall be shaded in such a manner that the intensity of the brightest square inch of light source presented to view from any normal working position does not exceed 3 candle-power. When local lighting is used the limits of permissible brightness are much lower than for lamps used for overhead lighting, because the eyes are more sensitive to strong light received

from below, and because such light sources are more constantly in the field of view.

Distribution of Light on the Work.—In class, study, recitation, laboratory, office, manual training, domestic science, library, sewing, drawing and drafting rooms, and all spaces devoted to similar uses, the maximum spacing between artificial lighting units shall not exceed 1.5 times the elevation of the unit above the work (the elevation of the work is usually 30 ins. above the floor). This is required to insure a distribution of illumination, which avoids objectionable shadows and contrasts of intensity on the work.

In all other spaces, except stairways, corridors and storage spaces, the mounting height and spacing employed with artificial lighting units shall be such as to secure a distribution of illumination over the floor area which is free from marked differences in intensity.

Switching and Controlling Apparatus.—Electric artificial lighting units in all rooms and spaces shall have switches or controlling apparatus at points of entrance.

Emergency Lighting.—Electric artificial lighting units of the main stairways, halls, corridors and exits shall be supplied from supply and branch lines entirely independent of the lines supplying the lighting for the remainder of the buildings.

Maintenance.—Windows and artificial lighting units shall be cleaned at sufficiently frequent intervals to maintain proper illumination. All parts of the artificial lighting system shall be frequently inspected and when found defective replaced or repaired. Lamps with heavily blackened bulbs should be replaced even though they may still be operated.

CO-OPERATION AS A MEANS OF INCREASING BUSINESS.

Service to Architects and Contractors Would Increase Allowances for Fixtures in New Buildings.

One of the possibilities of getting business which is not fully developed by many contractors is co-operation with the architect during the planning of large buildings or groups of houses. Architects require careful and diplomatic handling, for many of them consider themselves experts on lighting when their knowledge may in reality be rather fragmentary. The facts are that the architect has to know so much that his knowledge of some of the many branches of his business must of necessity be somewhat incomplete. The contractor can co-operate by getting on friendly terms with the local architects and offering assistance in solving the lighting and wiring problems. In this way he can often bring the architect to see that the usual 1% reserved for fixtures and lamps may in some cases be too much, but that in most cases such an allowance is absurdly inadequate. In this way he can often get the allowance raised to 3% and at the same time make a favorable impression.

Since, as a rule, the fixture contractor does not have time to devote to a deep study of the many problems of lighting, it might be well for the manufacturers to co-operate through or with their organization in maintaining at strategic points illuminating engineers whose business it would be to help the contractor dealer to lay out the job and to confer with the architect if required. This service should be free to the architect and the contractor because the enormously increased sales of fixtures would probably more than pay for the services of competent illuminating engineers. The raising of the percentage reserved for fixtures on a $500,000 job from 1% to 3% would amount to $10,000—surely enough to pay for the expense of laying out the job.

It is even possible that dividends might be earned and paid to the manufacturers and dealers backing the movement. Such earnings could be accumulated through the charging of a percentage fee against the successful contractor. Such a condition would serve to further consolidate and fix the organization through the medium of common interest and "better business for all." This service idea is being developed by various motor manufacturers, but so far none of them have attempted to benefit the trade as a whole in the manner suggested through a nation-wide movement. A more intensive study of the underlying principles of light and illumination is needed on the part of fixture manufacturers. The real key to better business lies, not in cut-throat competition, but in co-operation and the development of new and larger selling organization for the good of the trade as a whole.

RELATIVE ATMOSPHERIC SPECTRAL TRANSMISSION.

Light Transmission of Atmosphere Shown to Depend Upon Color or Wave Length and on Condition of Weather.

So far as it is permissible to draw conclusions from the observations made, three distinct curves of relative light transmission may be associated with three types of weather conditions, according to the findings of the Bureau of Standards as given in Scientific Paper No. 387. The three weather conditions are described as being of low humidity, overcast and high humidity, and rainy.

Within the visible range of the spectrum there is but slight evidence of selective transmission under conditions of low humidity; that is, all wave lengths that affect sight are transmitted by the atmosphere with about equal loss. However, in overcast and rainy weather such conditions do not prevail, there being a somewhat better transmission of light having an orange color. The transmission characteristics of overcast and rainy weather differ for certain wave lengths but are practically identical for those wave lengths which have the greatest effect upon the eye. In all cases there appears to be an increased absorption of light, or a reduction in transmission, as wave lengths increase above or diminish below certain values, the maximum of relative transmission falling within the range of vision.

Such information as is contained in the report is of material use in the design and selection of searchlights, headlights for automobiles and locomotives, lamps for lighthouses, and in the study and practice of aerial photography.

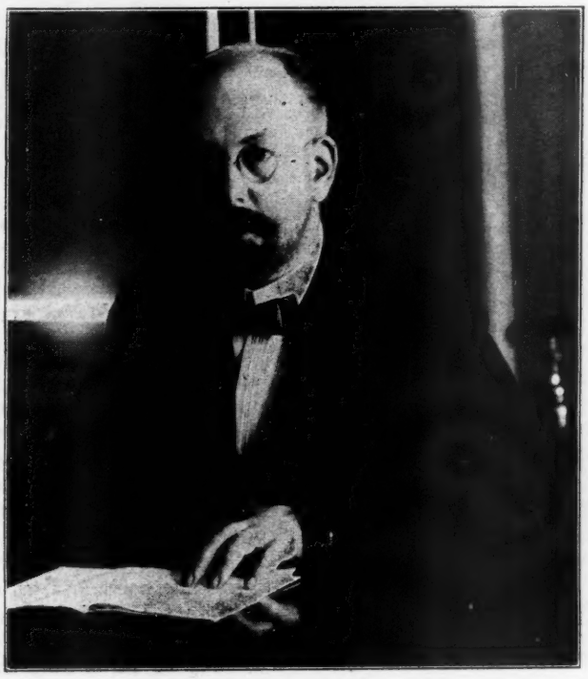
Illuminating Engineering Society Educational Plans

Program Providing for Increased Activity and Greater Dissemination of Knowledge on Lighting Subjects Outlined in Presidential Address at Cleveland Convention of Society

By S. E. DOANE

Past President, Illuminating Engineering Society.

The presidential addresses of my predecessors have been on varied topics. Each address bears evidence that the subject discussed was one which had been very much in the author's mind during his administration. The problems with which your executive deals each year are largely beyond his control and result from conditions so general that each administration has small opportunity to do what it would like to do were it entirely free. This was particularly true of the war-time administrations.



S. E. Doane.

My administration has been the first for a number of years in which conditions have made it possible to lay out a considerable amount of constructive work along the lines of normal activity of this society. The administrative period of one year is too short a time to permit a council and an executive to formulate new plans and to carry them through to a complete conclusion, but in the past year we have attempted to build a foundation for future progress along the lines so wisely laid down by the founders of the society and carried on by the preceding administrations.

Public Appreciates Need for Greater Knowledge of Illumination.

The great function of the society is educational. To a considerable extent we have been obliged in the past to gather together the material which we hoped would be accepted by science and industry as authoritative pronouncement around which progress in illumination would be made. I have been gratified beyond measure to find to what extent this society is accepted for just what it aims to be—a scientific society without commercial leanings or connections.

The year which has just passed has been marked by a public appreciation of the need for greater knowledge of illumination. It is my purpose in this address to review more broadly the course which this society is following and perforce must follow in the light of our present knowledge and announced aims. Our problem for the past year, for the ensuing year, and, I trust, for many years to come will be to find new ways and to make larger use of the old ways of wielding a greater influence, of increasing our knowledge and of furthering its dissemination. As we succeed in these aims, we shall find our membership increasing and our influence correspondingly growing.

This society is of use to a man from two entirely different standpoints. It is of use to a man when he needs assistance. It is of use to a man when he wishes to increase his usefulness to his fellowmen. Your council has agreed during the past year to an extension of educational work in a way which will be of benefit to both these phases of a man's need. In order to increase our value to the man who needs assistance, we must have that assistance in such shape that it is readily available. Now, since we are a scientific society whose very considerable function is educational, it is obvious that such assistance must be educational assistance.

To the man who would help his fellowmen, this society offers the opportunity of preparing the material which should be used in our educational effort. In practice, of course, no one of us falls wholly in either class. The man who seeks information today might furnish it tomorrow. The vehicle of usefulness or assistance is naturally the publications of the society. Our *Transactions* have fulfilled a most useful function, but in the judgment of your council and your president the time has come when their form should be changed and when we should organize for regularly issu-

ing material in other forms. The papers of this convention, following the precedent of previous years, will be published in the *Transactions* throughout the succeeding months. This is too slow a process. I believe that our papers should be bound and given to the members at the earliest possible date following the convention.

Society to Issue Symposiums and Compilations of Facts on Different Subjects.

I believe that the *Transactions* should be used as vehicles for the conveyance of new ideas, new papers, new facts, new material of all kinds and also for the discussion of this material. They should lead up to the issue on the part of the society of a new series of publications which will partake of the nature of bulletins or symposiums or exhaustive compilations on a subject.

It is obvious that such a program requires money and that without additional finances we could not do justice to this conception of our responsibility. It has been the good fortune of your retiring president, through his business connections and acquaintances, to so present the possibility of good to result from the support of such a program that sufficient assurance has been received to warrant him in announcing that barring the usual exceptions for the unforeseen, it is expected that your society will be able throughout the ensuing year to issue a series of bulletins on various subjects which will be compiled by the authorities on those subjects and which when issued will be sold to and used by manufacturing companies, central stations, sales organizations, and others. It is intended that the society shall itself make all these reprints for a price greater than the cost, so that the bulletins will be self-supporting and will contribute a sufficient sum to pay the necessary overhead which would be needed to take care of the program. I expect as a result of this agreement and program that we shall be able to furnish the educational institutions of this country, manufacturing companies, sales organizations, central stations, and all others who must needs gather such information and distribute it to their organizations and to their trade the best record of information and procedure on the subjects coming within our scope.

Establishment of Courses on Illumination in Public Schools and Other Schools.

The educational committee has done splendid work throughout the past year and has done so much preparatory work that it will show greater results throughout the ensuing year toward getting courses on illumination established in our colleges, high schools, grade schools, correspondence schools, and in the commercial and other societies and associations.

Several of the large manufacturing companies now publishing their own technical bulletins on general illumination subjects have agreed to present these compilations as papers to the Illuminating Engineering Society for discussion, committee revision, editing and acceptance, so that the manufacturing company intending to issue such a bulletin and sending it directly to the trade would submit it to the society as a suggestion for a bulletin. Through the proceedings and discussions of the society, the material would be referred to a committee on compilation and editing which would revise and publish it, sending it as a bulletin to the membership of this society and reprinting it, at a price in excess of the cost, for the manufacturer who employed the man who primarily wrote it, for others engaged in similar work, and anyone else in the industry who could use such a publication in its organization and with its trade. It is my belief that such an opportunity to increase our usefulness would attract the two classes of men to whom I have referred—first, the class which wishes assistance, and second, the class which is willing to render assistance. We have thus set the stage for a membership increase.

In the course of my work on the educational function of the society, I have run into a situation which I present for serious consideration. The sequence of thought is obvious. First, we have succeeded in demonstrating to the country the need for better illumination. Second, the acceptance of this view has raised the need for an augmented effort along educational lines. Third, when we review the field to fulfill this need we find another matter of the greatest seriousness, which is the need for financial recognition of the men who are engaged in scientific work outside of the strictly industrial field. In this class fall the teachers of our schools and the scientists in government employ.

Scientists and Educators Forced to Take Up Industrial Work.

The exodus of educators from our colleges and universities and of scientists from governmental bureaus has reached truly serious proportions. These men are finding employment as specialists in large organizations which do not hesitate to pay substantially more than most educational and governmental institutions find it possible to offer.

The true scientist is a peculiar individual in certain respects. His love for his work is second only to his love for his family and his home. Money seems to have small attraction for him as long as he is able to live with a fair degree of comfort. The pleasures that most of us find away from our desks, outside the confines of our daily problems, the scientist finds in fullest measure deep in the intricate details of his work.

In the past few years, however, the cost of living has intruded upon his consciousness. It has insisted upon recognition. In the cases of many men wedded to their work it has presented nothing short of an ultimatum. The result has been that men who have refused to consider really handsome offers from industrial plants in the past because of their love for the work they were engaged in have been forced at last to accept outside offers in order that they and their families might live decently and comfortably, and lay a little aside for the proverbial rainy day.

I understand that certain educational institutions have endeavored to adjust their salary scales sufficiently to retain the men who act as the educators of your children and of my children. Undoubtedly others will follow suit. As educated men ourselves, we cannot afford to leave the future instruction of our young manhood and womanhood to men not in industry because they are not competent to be in industry.

Improved Methods of Illuminating Motion-Picture Theaters

Theoretical and Practical Considerations — Results Obtained With Experimental Theater—General Conclusions and Suggestions—Paper Presented Before Illuminating Engineering Society

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In the early days of the motion-picture industry it was customary to present pictures in a room containing practically no illumination other than that resulting from the light reflected from the screen. This procedure may have been justified to a certain extent, because screen illuminations were very low, making it necessary to exclude practically all light from the room in order that the resultant picture might appear to be of satisfactory brightness. With the progress in development of projection apparatus the screen brightness has been raised continually, until at the present time such values are relatively high. Improvements in the quality of the photographic materials have resulted in better positives for projection, which also tends to give pictures of greater clearness and brilliancy. Along with this tendency to increase the screen brightness, modifications of the interior illumination of motion-picture theaters have taken place. The trend has been in the direction of increased room illumination and with the appearance of the higher class theaters, devoted exclusively to the exhibition of motion pictures, has come considerable development in the art of interior illumination of such places. The existence of higher screen brightness naturally permits of greater illumination without serious interference with the quality and brightness of the projected pictures.

Reasons for Proper Amount of General Lighting in Theaters.

The desirability of providing sufficient illumination for the convenience and comfort of the audience, if this can be accomplished without perceptible loss of quality in the projected picture, is obvious. It is scarcely necessary to enumerate the many serious objections to the use of very dimly lighted rooms in which motion pictures are being exhibited to large audiences. The difficulty encountered by persons entering from the relatively brightly lighted exterior regions in finding their way to unoccupied seats is considerable. The undue strain thrown upon the accommodation processes of the retina resulting from a sudden transition from a brightly lighted exterior to a dark interior, or *vice versa,* is to be avoided if possible. More serious than these, however, is the excessive visual fatigue and eyestrain resulting from a prolonged observation of the brightly illuminated area (such as the screen on which the picture is being projected) occupying but a small portion of the field of view, surrounded by very dark areas, this condition being ideal for the production of glare effects due to excessive contrasts. Furthermore, in such dimly lighted interiors it is quite impossible for the management to supervise adequately the conduct of individuals in the audience, a fact which has led to some criticism of such places of entertainment. It is evident for the satisfactory exhibition of motion pictures that the general illumination in the theater must be subdued in order that the projected picture shall be of good quality as regards its apparent brightness and contrast, and that in raising the value of the general room illumination there is a limit beyond which it is impossible to go without seriously affecting these characteristics of the picture.

While a great deal has been done in improving the character of the illumination of such theaters, the problem seems to have been approached largely from the purely practical standpoint with the object of producing artistic effects and the enhancement of the ornamental detail of the interior rather than with the idea of producing maximum visual comfort for the audience, while at the same time maintaining satisfactory photographic quality in the projected picture. It, therefore, has seemed worth while to approach the problem from the standpoint of the retinal sensibilities, and to link up the conclusions drawn from such a consideration of the subject with those resulting from practical tests.

From a consideration of the available data relative to the various sensibilities of the retina to brightness and brightness differences, it is evident that a picture having a definite objective contrast may in some cases be made to appear more contrasty if observed under different conditions of illumination. For instance, if the conditions of viewing are such that the retina is operating at a low adaptation level such that its sensibility to contrast (*i. e.,* brightness difference) is small, enhancement of the apparent contrast can be obtained by so changing the conditions of illumination that the retina is operating at a higher level where its sensibility to contrast is greater. Applying this reasoning to the case of an observer in a motion-picture theater, it seems reasonable to assume that it might be entirely possible by using an increased amount of general room illumination to make the projected picture appear more contrasty than with a smaller amount of such illumination. On the other hand, any attempt to raise the level of illumination in the body of the theater will most probably result

in an increased amount of scattered light incident upon the projection screen, which, since it is superimposed equally on both the high-light and shadow regions of the picture, will result in a lowering of the actual objective contrast. From purely theoretical considerations, therefore, it would seem that the use of higher illumination levels in a motion-picture theater will result in two effects which operate in opposite directions upon the apparent contrast of the picture being projected.

Room Illumination Increased Without Interference to Picture Projection.

It seems possible, therefore, that the illumination levels in the body of the theater may be raised to levels much higher than those customarily used at the present time without in any way interfering with the apparent contrast of the projected picture. It also follows that with the higher adaptation levels the apparent brightness of the picture will be less than at the lower adaptation levels, but since screen brightnesses at the present time are relatively high a slight sacrifice in the apparent brightness can be made without serious results. In fact, in many theaters the high-light portions of the pictures are so bright as to cause a visual discomfort, and a more pleasing effect may result if such pictures were viewed with an eye adapted to a higher brightness level. This brief consideration of the fundamental characteristics of the retina makes it possible to draw certain general conclusions as to the most desirable conditions of illumination for the purpose. The data available, however, are not sufficiently complete to permit the computation of the desired values, and hence it is necessary to resort to experiment and to actually measure in an experimental installation the illumination which is permissible, the permissible illumination being defined as the maximum illumination which may be employed without causing a perceptible loss of quality in the projected picture.

General Theory as Affects Brightness Sensibility of Observer.

Before proceeding with an account of the experimental work, it may be well to consider in more detail the general theory of the subject and the fundamental characteristics of the eye which are important in problems of this nature. First of all, it should be borne in mind that the sensation produced when light falls upon the retina depends upon several factors such as the intensity of the light, the length of time during which the stimulation continues, wave length of the radiation, the size and shape of the retinal area stimulated, and the physiological conditions of the retina due to previous action of light upon it. It is sufficient for the present purpose to consider only the reactions of the retina to the intensity factors of the stimulus and neglect those which are functions of its quality.

Of first importance among the factors requiring consideration is the sensibility of the retina to brightness. There are three types of brightness sensibility: (1) threshold sensibility, which is measured by the least brightness perceptible; (2) contrast sensibility, which is measured by the least brightness difference perceptible, and (3) glare sensibility, which is measured by the brightness just sufficient to produce discomfort when observed.

Now the sensibility of the eye to brightness, contrast and glare depends upon the condition of the retina at the particular time the determination is made, and that condition is in turn dependent upon the previous stimulation. Hence, it is necessary to specify the condition of the retina at the time the measurement of sensibility is made. This is done by specifying the brightness, to which the eye is adapted, and is termed the "adaptation level" of the retina. For instance, when an observer looks for some time (10 to 30 min.) at a uniformly illuminated surface so large as practically to fill the field of vision, a condition of equilibrium in the retinal process is reached, and the observer's eye is said to be adapted to the brightness of the field, and his "adaptation level" is specified by stating the brightness of the illuminated surface, which is sometimes termed the "sensitizing field." It is found that the sensibility of the retina varies

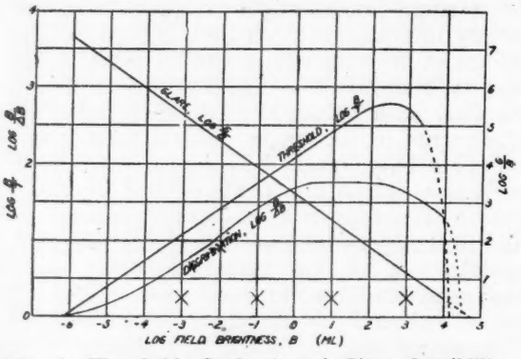


Fig. 1.—Threshold, Contrast and Glare Sensibility Curves.

over very wide limits depending upon the adaptation level; in fact, due to this variable sensibility, it is able to operate over a range of brightness from 1 to 100,000,000 (approximately). A complete expression of sensibility, therefore, requires measurement over the entire adaptation range, and the results are most conveniently expressed in graphic form as curves plotted with values of the various types of sensibility (threshold, contrast and glare) as ordinates and the adaptation level is abscissae. These three sensibility curves are given in Fig. 1.

Since the variation in value of adaptation level (field brightness) is enormous, it is convenient in plotting the curves to use the logarithms of these values. The ordinates are expressed in units appropriate to the various types of sensibility. For any specified adaptation level it is now possible to read from the curves the brightness which is just uncomfortable (producing glare), the least perceptible difference in brightness (contrast), and the least perceptible brightness (threshold). Applying this to the case of an observer in a motion-picture theater, we are able, if his adaptation level is known, to find to what extent any area may be illuminated without producing glare, to compute the amount of general illumination which may be tolerated on the screen without producing a perceptible degradation of contrast, or to specify the maximum of

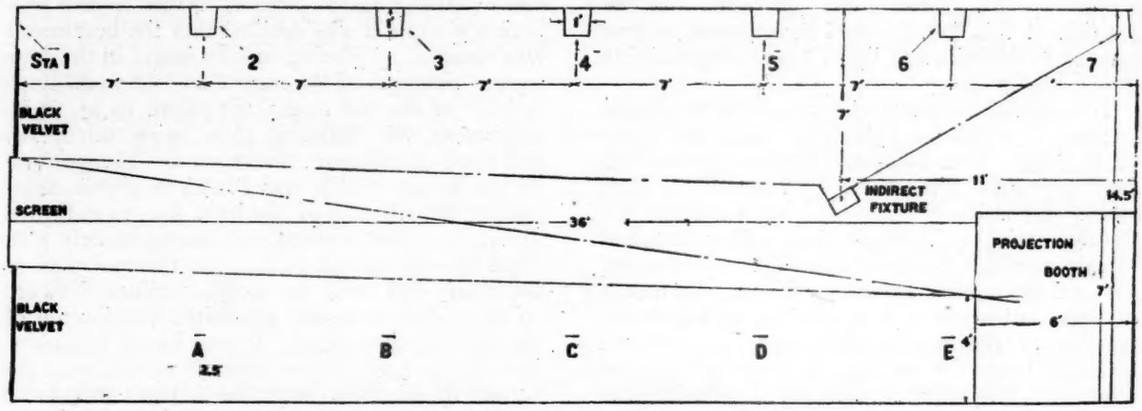


Fig. 2.—Side Elevation of Experimental Motion-Picture Theater.

brightness difference in the field of vision if undue eye fatigue is to be avoided.

In order to make such useful application of the fundamental data contained in the sensibility curves, it is, however, necessary to know the adapation level of the observer under the particular conditions considered. Unfortunately the data necessary for this are not at present available. It will be recalled that the "adaptation level" is defined as specified by the brightness of a uniformly illuminated field filling the entire field of vision, and the retinal sensibilities were determined under such conditions. Now it is probable that the brightness of the foveal image is the most important factor in fixing the adaptation level of the retina, but undoubtedly the brightness of the images outside of the fovea have some influence. In the case of a person watching a motion picture, the picture itself usually occupies but a relatively small portion of the visual field, and in case the surrounding areas are very low in brightness his adaptation level will probably be somewhat lower than indicated by the average picture brightness. The effective application of the sensibility data, therefore, depends upon a reliable determination of the adaptation level under practical working conditions in the motion-picture theater. An instrument is at present being developed with which the adaptation level of the retina when stimulated by nonuniform fields may be measured. It is hoped when such measurements are available that the application of the sensibility data will lend additional support to the conclusions reached in the experimental work to be described.

In order to make an actual determination of the maximum general illumination permissible, an experimental lighting system was installed in the projection room in the research laboratory. In designing this system an attempt was made to obtain the maximum average illumination on the table plane (horizontal surface 30 in. above the floor) with a minimum of illumination on the projection screen, and further to distribute the light so that no area either of wall, ceiling or lighting fixture should be sufficiently bright to cause glare or appreciable increase in the adaptation level of the observer.

In Fig. 2 is shown a side elevation of the room, with the locations of the various elements of interest in this problem and the dimensions of importance. In Fig. 3 is given a plan view showing the position of the stations on the table plane at which measurements of illumination were made. The ceiling of this room is painted white, while the walls are a medium tone of buff. The projection screen is of the metallic type (Gaumont), having a high reflecting power for points on and near the axis, but falling off rapidly for angles greater than 15 deg. from the axis.

The lighting fixture used was constructed by mounting six 10 by 12 darkroom ceiling lamps on

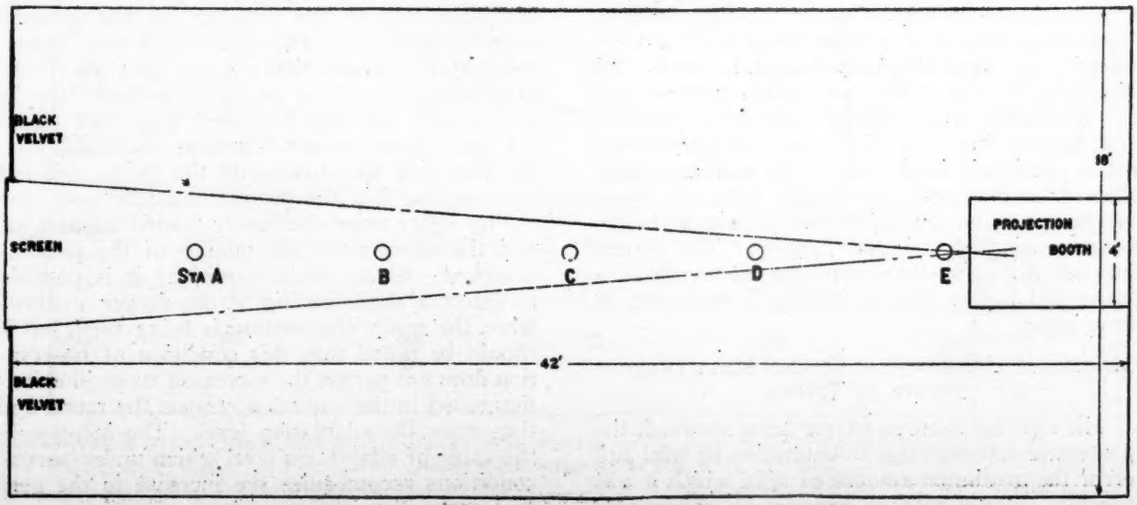


Fig. 3.—Plan View of Experimental Motion-Picture Theater.

a light wooden frame work. In order that the position of this fixture could be adjusted to give various distributions of light, it was suspended as shown in Fig. 4.

The vertical members *AA* carry the horizontal member *B*, which is a cylindrical metal rod about 21 ft. long. One of these fixtures is mounted near each side of the room, and parallel to each other. Upon these horizontal ways operate the sliding carriages *C*. Over small pulleys attached to this carriage the sash cords *FF* operate and suspend the lighting fixture as shown. By means of these adjustments it is possible to adjust the position of the lighting fixtures to any desired distance from the ceiling, to vary its distance from the projection screen by a considerable amount and further to vary the inclination at which the fixture hangs thus controlling to a great extent the distribution of the light from the fixture.

Complete diffusion of the light from the incandescent lamps mounted in the fixture was obtained by inserting a sheet of 10 by 12-in. opal glass in the position provided for holding the safelight. In the projection booth is situated a projection machine of the ordinary type. An arc current of 25 amperes was used throughout the tests recorded in this report. With this current the screen brightness as measured with the machine running but without a picture in position was found to be approximately 20 foot-candles. This measurement was made from a point very near to the axis of projection and due to the character of the screen was much higher than the brightness measurement made from points a few degrees from the axis. From measurements made previously in several of the motion-picture theaters in Rochester, an average value of screen brightness under similar conditions was found to be approximately 15 foot-candles. The screen brightness used in these experiments therefore is somewhat higher than is ordinarily met with in practice.

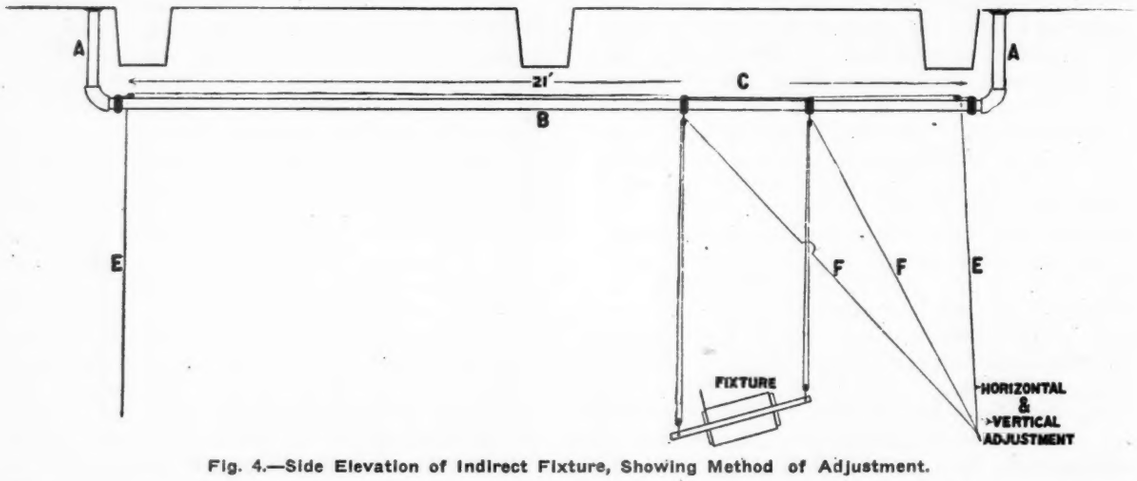


Fig. 4.—Side Elevation of Indirect Fixture, Showing Method of Adjustment.

Maximum Amount of Room Illumination Found by Trials.

The lighting fixtures having been installed, the procedure followed was to determine by trial and error the maximum amount of light which it was possible to use without causing an appreciable loss of quality in the picture. After several preliminary trials it was decided that the best result was obtained by placing 60-watt lamps in the four central elements of the fixture and 40-watt lamps in each of the end boxes, the entire 10 by 12-in. surface of the diffusing glass being uncovered and used as effective source area. The position of the fixture which was found to give a satisfactory distribution of the light was as indicated in Fig. 5. This position was approximately 5 ft. from the ceiling and 11 ft. from the rear wall of the room, and with the fixture inclined forward so as to give an evenly graduated distribution of the light on the ceiling. It was found necessary, in order to prevent excessive illumination of the screen by the light from the fixture, to place a cardboard screen along the front of the frame carrying the safelight fixtures. This was of such dimensions that no direct light from the opal glass was permitted to fall upon the projection screen, and served also to reflect some of the light backward so that the ceiling brightness at the rear of the room was brought up to a value more nearly equal to that of the brightness of the ceiling directly above the fixture.

This arrangement having been reached and considered satisfactory several observers experienced in the judgment of photographic quality were asked to express opinions as to whether or not the quality of the projected picture was seriously affected by the presence of this general room illumination. These observers were unanimous in the decision that not only was the photographic quality of the projected picture fully as satisfactory, but that the effect was more pleasing and resulted in much greater visual comfort. By observing the screen with the eye so shielded that nothing but the picture could be seen, the ceiling lights were alternately turned off and on, and the effect upon the quality of the pictures observed. Under such conditions it is possible to detect a slight veiling of the deeper shadows when the room illumination is being used, but it should be noted that this condition of observation does not permit the increased room illumination to act in the normal way upon the retina and thus raise the adaptation level. The increase in the value of adaptation level which under normal conditions accompanies the increase in the general room illumination under such conditions is

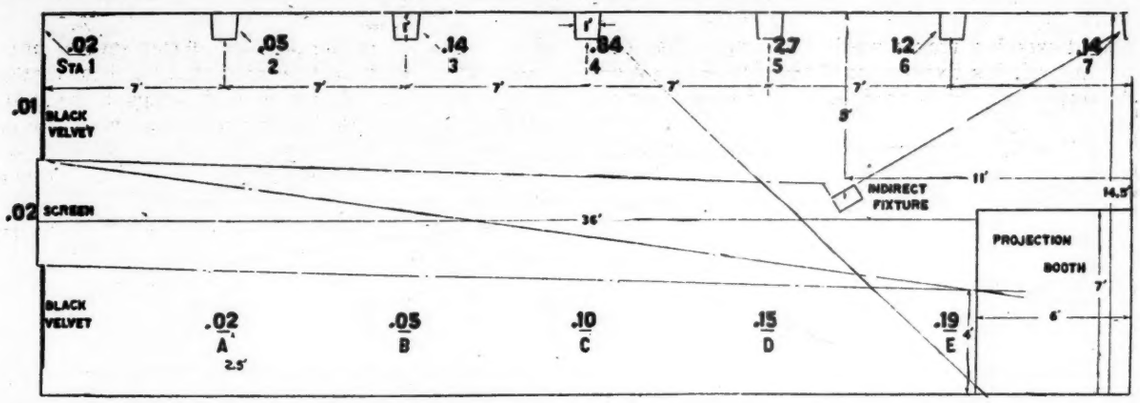


Fig. 5.—Side Elevation, Showing Fixture in Position Which Gave Satisfactory Results; Illumination Values at Different Stations.

therefore prevented from compensating for the objective loss of contrast due to the presence of the veiling glare incident upon the projection screen when the illumination levels of the room are high.

The veiling illumination falling upon the screen due to the general illumination in the room is sufficient to cause an easily measurable decrease in the actual objective contrast of the picture. The picture observed in the normal manner, however, with the eyes not shielded so as to prevent the action of the room illumination on the peripheral region of the retina, appeared to be of practically the same contrast as when the room illumination was not used. The explanation of why the actual decrease in objective contrast produces such a small apparent effect is of fundamental importance; as mentioned previously, it is due to the fact that the contrast sensibility of the retina rises with increase in the value of the adaptation level. The presence of the general room illumination is responsible for a rise in the adaptation level of the observer and the corresponding increase in contrast sensibility permits the perception of smaller brightness differences.

On the whole this arrangement was considered very satisfactory by all those observing. One point of interest noted was that much less visual discomfort resulted when the screen brightness was suddenly changed by the appearance of the title region of the film, and further that a slight residual flicker due to lack of precise shutter adjustment was less noticeable. In fact, much less general eye fatigue resulted when the room lights were on than when they were turned off.

In order then that a permanent record of the quantity and distribution of illumination used might be made, a series of brightness and illumination measurements were made. The points at which measurements were made are indicated in Fig. 2. The stations *A, B, C, D* and *E* represent points on the table plane, 30 ins. from the floor, while the stations 1, 2, 3, 4, 5, 6 and 7 are situated at various points on the ceiling as indicated by the arrows and represent the points of maximum brightness as seen by an observer situated at a point near station *D*. All values of brightness are expressed in millilamberts and those of illumination in foot-candles. In order that a complete analysis of the distribution of the light might be made, sets of measurements were made under four conditions of illumination, the data obtained being classified according to the following system.

Group I.—Room illumination only.

Group II.—Room illumination; 25-ampere arc in projecting machine; machine running but with no picture.

Group III.—The 25-ampere arc in projecting machine; machine running.

Group IV.—Room illumination; 25-ampere arc in projecting machine; normal positive film in machine running.

The measurements obtained under Group I indicate the intensity and distribution of the light from the installed fixture. The data in Group III

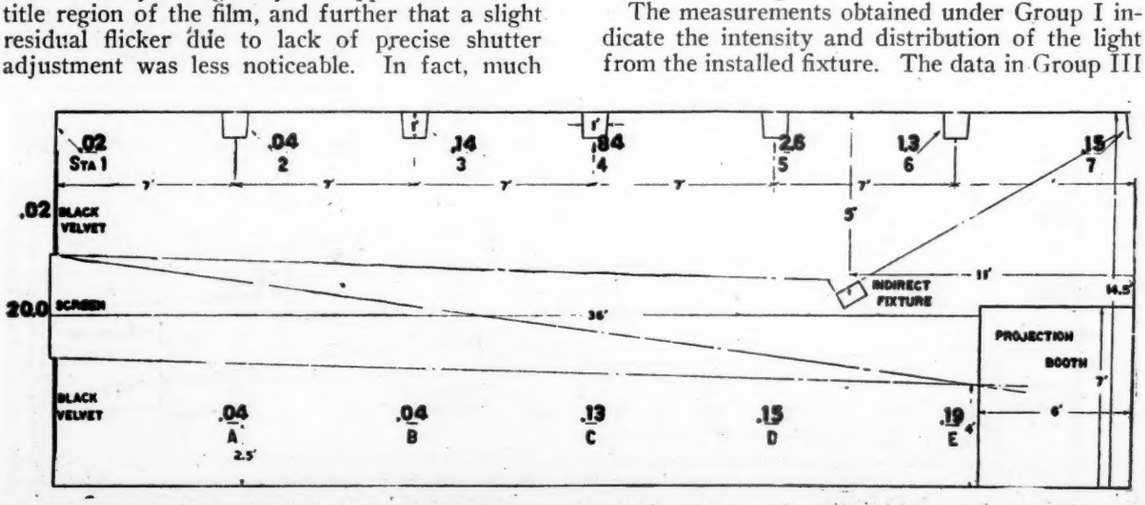


Fig. 6.—Values Giving Distribution of Illumination With Picture of Normal Density Being Projected on Screen and Room Illumination as in Fig. 5.

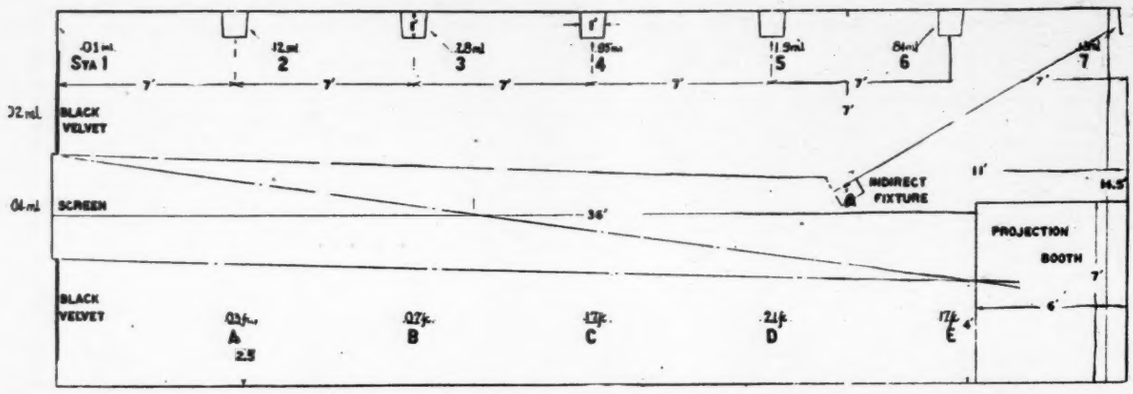


Fig. 7.—Data Obtained With Indirect Fixture on Lower Level Than That Indicated in Fig. 6; Increased Illumination Near Front of Room.

represent the intensities and distribution of the light reflected from the screen when the arc is operating, but with no picture in the machine. The data in Group IV are of greatest interest, as they represent the distribution and intensity of the illumination under actual operating conditions, the sources of light being both the installed fixture and the light reflected from the projection screen. The data in Group II were recorded as being of interest in indicating the difference between the illumination with and without a picture in the projecting machine.

The measurements having been completed with this arrangement of the lighting fixture, it was decided to make a second adjustment and to repeat the measurements with slightly changed conditions. The distance between the fixture and ceiling was increased to 7 ft., and the inclination changed somewhat so that while the projection screen was protected from direct light a higher ceiling brightness near the front of the room was obtained. In the opinion of the same group of experienced observers, this second arrangement of the illumination was quite as satisfactory from the standpoint of photographic quality in the projected picture as the first arrangement. From the standpoint of the room illumination the arrangement was somewhat more satisfactory owing to the fact that a more uniform distribution of brightness over the ceiling and a slightly higher illumination level near the front of the room was obtained. The photometric measurements were then repeated from the same set of groupings as employed previously.

In order to present this data in more graphic form, the values of brightness illumination are written in on the proper points on the prints showing the side elevation of the room, and a brief consideration of these will now be taken up. In Fig. 5 is shown the distribution of illumination due to the installed fixture in the first position found satisfactory. The position and inclination of the fixture is indicated approximately in the figure. It will be noted that the highest ceiling brightness occurs at Station 5 where a value of 2.5 millilamberts was found, the brightness decreases in both directions from this maximum, being relatively low on the ceiling near the projection screen. It will be noted also that the illumination on the table plane increases in a fairly regular manner from the rear to the front of the room, the maximum value being 0.19 foot-candles at Station *E* and 0.02 foot-candles at Station *A*. In Fig. 6 is shown the distribution of illumination under actual operating conditions, a picture of normal density being projected with the room illumination as indicated in Fig. 5. It will be noted that due to the light reflected from the projection screen the values of illumination near the front of the room are somewhat higher than under the conditions represented in Fig. 5.

In Fig. 7 are given the data obtained with the second arrangement of the fixture, and it will be noted that the maximum ceiling brightness has been lowered somewhat while higher brightnesses are found near the front of the room; thus a more even distribution of ceiling brightness is obtained with this arrangement. The illumination

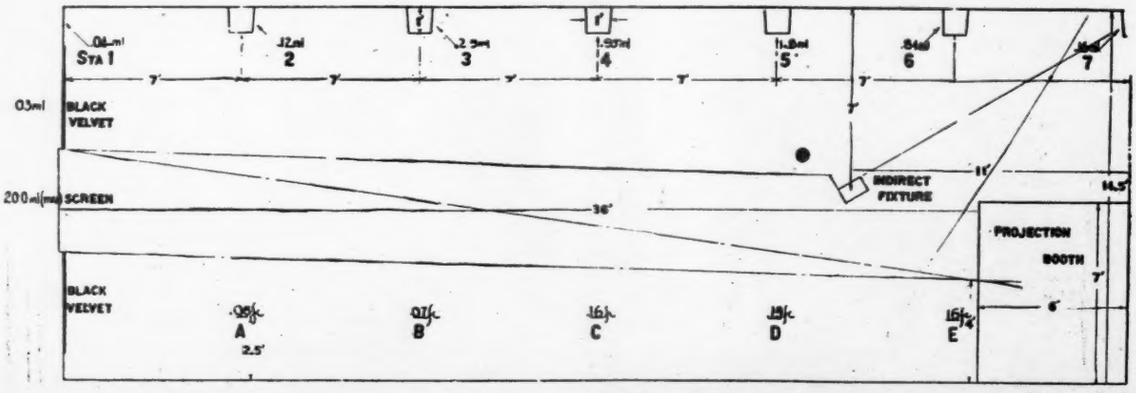


Fig. 8.—Values Giving Distribution of Illumination With Picture of Normal Density Being Projected on Screen and Room Illumination as in Fig. 7.

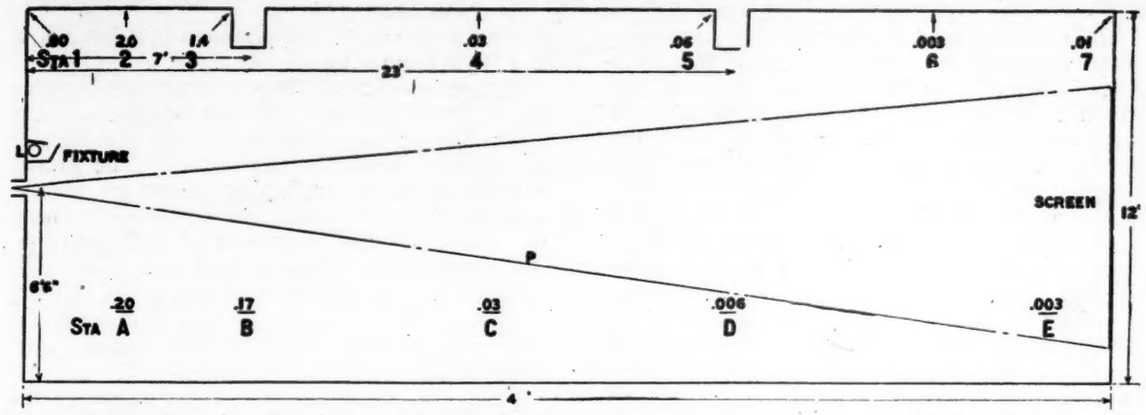


Fig. 9.—Another Type of Lighting Installation, Values Giving Distribution of Illumination and Ceiling Brightness With Room Lamps Only in Operation.

on the table plane is also somewhat higher and more evenly distributed.

In Fig. 8 the data obtained with the second arrangement being used under actual working conditions are shown.. It will be noted that the illumination on the table plane now varies from a maximum of 0.19 at Station *D* to a minimum of 0.06 at Station *A*. Both of the arrangements specified by the values in Figs. 6 to 8 were found to be entirely satisfactory from the standpoint of picture quality, the second arrangement providing better general room illumination. With this illumination it is quite possible after becoming accommodated to the existing brightness level to read with comfort ordinary newspaper print, and furthermore the length of time required for accommodation is very short. For instance, an observer entering a room with his eyes adapted to full exterior daylight levels can see immediately all details of furniture in the room, and a period of not more than 1 or 2 min. is necessary for adaptation sufficient to read with ease ordinary printed material.

The details of another installation of somewhat different type but involving the use of the same fundamental principles are shown in Figs. 9 and 10. This is a room used for the exhibition of motion pictures, and while it is not of dimensions comparable with commercial motion-picture houses, it serves to illustrate another way in which a satisfactory distribution of light may be obtained. The fixture providing the room illumination consists of a trough that extends across the entire width of the room. This is mounted in the position, as indicated by the word "fixture," on the rear wall of the room and just above the projection port. The diagram shows a cross section of this fixture while the circle inside indicates the position of the lamps which are 25-watt, full frost spherical bulbs. Sixteen lamps are used, assembled on two circuits so that 8 or 16 may be used as desired. The walls of this room are painted dark gray while the ceiling is white. The projection screen in this case is approximately 10 by 12 ft., being of white plaster from which the light reflected is almost completely diffused. With an arc current of 40 amperes and the machine running without film, the screen brightness was approximately 5 millilamberts and was practically constant for all angles of observation. Fig. 9 indicates the distribution of illumination and ceiling brightness with the room lights alone, while Fig. 10 indicates conditions existing when a picture of normal density is being projected. Due to the fact that the lower edge of the screen is only about 15 ins. from the floor level, it is impossible to seat observers nearer to the screen than the point indicated by *P* in each diagram. It was only necessary therefore in this case to provide adequate illumination in the region between *P* and the rear of the room. It will be noted that in this region the illumination on the table plane varies from 0.20 foot-candle to 0.04 foot-candle, while the maximum ceiling brightness is 2.0 millilamberts at a point midway between the rear of the room and the first beam.

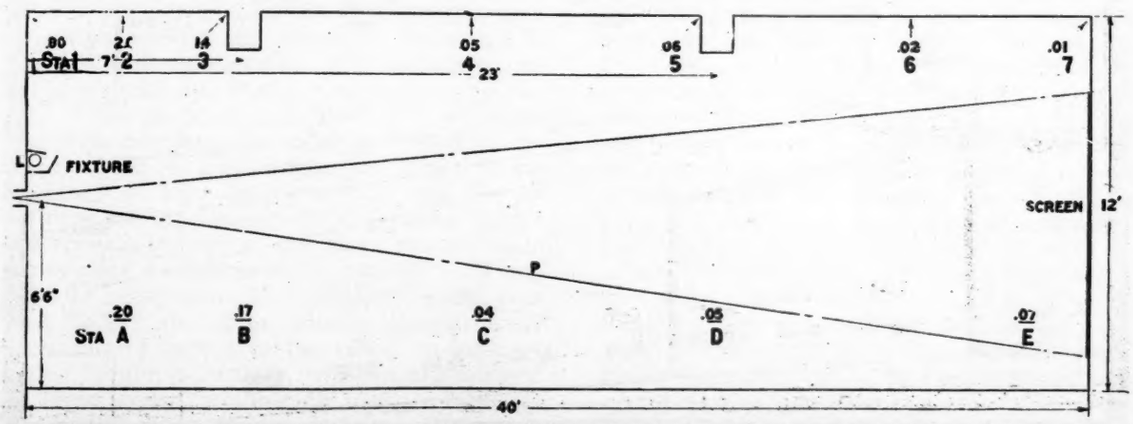


Fig. 10.—Values Giving Distribution of Illumination With Picture of Normal Density Being Projected on Screen and Room Illumination as in Fig. 9.

All values designated at Stations 1 to 7 inclusive are in millilamberts while those at Stations *A* to *E* are values of illumination in foot-candles. The screen brightness with the room lights alone is 0.007 millilamberts. This illumination is very satisfactory, the picture quality being in no way degraded by its use. The bottom of the interior of the fixture is painted black so as to prevent an excessive ceiling brightness immediately above the fixture, while the rear of the interior is painted white in order that the brightness of the ceiling at points farther forward in the room may be enhanced. The lamp bulbs used in this case were dipped in a light yellow lacquer, thus producing a softer and more pleasing effect than when the undipped bulbs were used.

The general conclusions to be drawn from these experiments are that a relatively large amount of general illumination may exist in motion-picture theaters without appreciably affecting the quality of the projected picture provided that this illumination is properly distributed.

In Fig. 11 is shown a possible arrangement of the lighting system which would give a highly satisfactory theater illumination. This plan is presented as illustrative of one way of handling the problem and undoubtedly many others may be worked out.

The ceiling which consists of four arches or concavely curved surfaces is illuminated by lamps inclosed in the fixtures as indicated, the intensity of the various lights being arranged roughly as indicated by the numbers i = 1x, i = 4x, etc. This would result in a relatively high ceiling brightness at the rear of the theater and a relatively low value at the front. Since the lamps themselves must be placed comparatively close to the ceiling it would be necessary in order to obtain an approximately uniformly graded ceiling brightness to arrange the decorative scheme applied to the ceiling so that region marked *B* would have a relatively low reflecting power, while those marked *A*, on the other hand, would have a very high reflective power. While the details of such decorative system have not been worked out, it is undoubtedly possible to achieve. The lighting of the ceiling underneath the gallery is obtained from lamps at *B*, and here again the ceiling reflecting power should vary from a low value at *B* to a high value at *A*.

The desirability of close co-operation between the lighting engineer and the designer of the decorative scheme to be applied to the interior of the field should be emphasized. The proper adjustment of the reflecting power of various wall and ceiling elements is a powerful factor in the control of the brightness of such surfaces, and considerable judgment and skill in the adjustment of the decorative scheme to the lighting system may be necessary in order to prevent certain surfaces very close to light sources used from having excessive brightness.

From the results of the experiments in the projection room, it has been concluded that the illumination on the table plane at various points in the theater should be approximately as indicated by the values of *E*, and the number and size of the light units used should be so adjusted as to give the indicated values. While an approximate computation could be made indicating the number and size of units necessary, it would be quite impossible without detailed information of the dimensions of the room, the reflecting power of various surfaces, and the exact position of the lamps to make a definite estimate as to the total quantity of light flux necessary.

In Fig. 12 are shown three cross-sectional diagrams illustrating the possibilities in beam design which would result in a satisfactory distribution of the light flux over the ceiling. These designs, of course, are only given as suggestions of what might be done in arranging an indirect system of illumination in order to conform with the conditions outlined previously in this report. The beam structure adopted in any particular case will be influenced to a great extent by the architectural style of the theater and the diagrams given serve only to suggest a method of concealing the lamp within the beam structure and at the same time obtain the proper illumination of the ceiling.

It should be mentioned also that the illumination in the lobby and in the various vestibules and extreme rear of the theater should be so arranged that a person entering the theater passes gradually from the illumination of the exterior to that

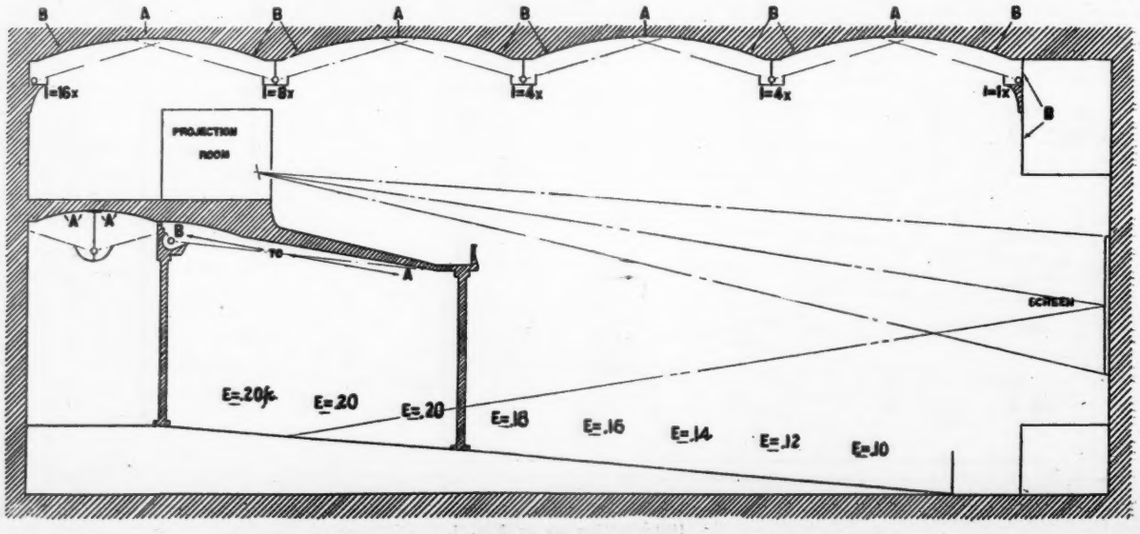


Fig. 11.—Suggested Plan for Illumination of Motion-Picture Theater.

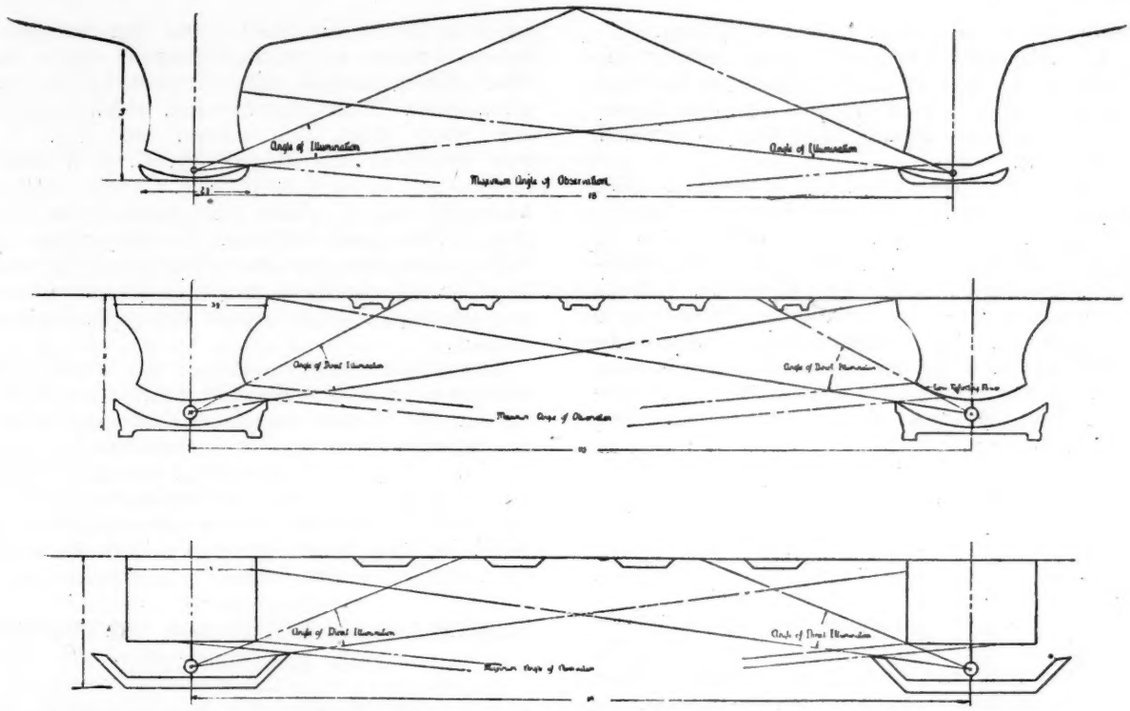


Fig. 12.—Three Suggested Types of Beam Design Intended to Provide for Suitable Lighting of Ceiling Areas.

of the body of the theater; that is, the transition from exterior brightness level to the interior brightness level should be made in a series of gradual steps rather than in a single abrupt step.

Turning to a consideration of the brightness of the frame surrounding the picture, it was found by experiment that raising the brightness of the frame to a value of approximately 0.02 millilamberts gave a much more pleasing effect than when the black velvet frame was used, in which case the brightness was so low as to be beyond the limit of measurement with the instrument available. The contrast between the frame and the highlight of the projected picture, which is estimated to have been about 1 to 10,000 in case of the black velvet frame, was found to give rise to a certain feeling of visual fatigue and discomfort. By covering the velvet with a draping of white mill net the reflecting power was increased to such an extent that the contrast between the frame and picture was considerably reduced. It will be noted that the average screen brightness without any picture in the screen is found to be 20 millilamberts. The average screen brightness with a normal film in position is probably of the order of 2 millilamberts, while the maximum may be taken to be somewhere in the neighborhood of 10 millilamberts. With a frame brightness of from 0.02 to 0.03 as indicated by the data, the maximum contrast between picture and frame is reduced to less than 1 to 1000 while the average contrast is approximately 1 to 100. Now the sensitometric data on glare indicate that with the eye adapted to ordinary daylight levels a contrast of over 1 to 100 results in glare or undue fatigue. However, with the eye adapted to lower levels, the allowable contrast increases to a considerable extent and if (see Fig. 1) we assume an adaptation level of 1 millilambert, the data indicate that contrast as great as 1 to 1000 may occur in the visual field without resulting in glare or undue visual discomfort. Contrast greater than this, however, should not be permitted. These results indicate that in general a black frame should not be used, but that a much more pleasing and less fatiguing arrangement will be obtained by the use of a frame of somewhat higher reflecting power.

General Conclusions.

It is quite possible to use a system of lighting in a motion-picture theater which will result in illumination levels on the table plane much higher than those at present prevailing. The illumination may, in fact, be raised to such an extent that ordinary newspaper print may be read with ease by an observer adapted to the existing brightness levels. The presence of this increased illumination does not cause any appreciable degradation of quality in the projected picture. The accomplishment of such satisfactory results depends upon the proper distribution of the light.

While it is impossible to outline specific instructions for particular cases without detailed knowledge of such factors as dimensions and architectural details of the room, the reflecting power of the various ceiling and wall surfaces, and the position of the light fixtures, the following general principles may be outlined, it being understood that the numbered values are approximate and that some variation may be allowable depending upon the particular case.

(1) The illumination on the table plane should vary from 0.10 foot-candles at the front of the theater to 0.20 foot-candles at the rear.

(2) No area (outside of the projected picture) visible from any seat in the theater should have a brightness of more than 2.5 to 3.0 millilamberts.

(3) The attainment of (1) without exceeding the values mentioned in (2) requires the use of very extended effective sources such as illuminated ceiling and walls and is best accomplished

by the use of an indirect system of lighting.

(4) All light sources and fixtures such as diffusing globes and translucent glassware having a surface brightness of more than 2.5 to 3.0 apparent foot-candles should be entirely concealed from view.

(5) It should be noted that a sheet of white paper illuminated by a 25-watt lamp at a distance of 12 ins. has an approximate brightness of 20 apparent foot-candles. A sheet of music, therefore, illuminated in this way, if visible, becomes a glare spot and may cause great discomfort to the audience. Arrangements should therefore be made which, while providing adequate illumination for the musicians in the orchestra, will prevent the illuminated music sheets from being visible to the audience.

(6) Considerable attention should be paid to the character and position of exit signs. While it is necessary to make such signs very conspicuous, this can be accomplished without making them so brilliant as to become disagreeable glare spots in the field of the observers' vision.

(7) The contrast between the highest light of the picture and the surrounding frame should be less than 1 to 1000, preferably less than 1 to 500. Black frames should, therefore, be avoided, one of a neutral gray being much preferable.

(8) Lighting of lobby, vestibules, etc., should be so arranged that the transition from the brightness level of the exterior to that of the interior or vice versa is accomplished by a series of small differences rather than by a single large one. Such arrangement will to a great extent eliminate the visual shock which accompanies a sudden change in the intensity of the visual stimulus.

(9) The use of a projection screen set well back on the stage and thus shielded to a great extent from the light reflected from ceiling and walls would probably permit the use of even greater room illumination than was used in these experiments.

THERMAL DILATION OF GLASS AT HIGH TEMPERATURES.

In an investigation undertaken in connection with Bureau of Standards production of optical glass, the dimensional changes of various glasses in the annealing and higher temperature region were determined. Upon requests from several glass manufacturers a number of their commercial products were also investigated. The results of these tests and investigations are reported in Scientific Paper No. 393 of the Bureau of Standards.

A Fizeau-Pulfrich interferometer was used for this work, since the extreme sensitiveness of this instrument made it possible to use small specimens, and the small size of the apparatus simplified the problems of uniform heating and temperature control. Using straight fringes produced by the yellow radiation from a helium source, the dimensional change for a given temperature interval was given by the number of fringes which passed the reference mark on the front interferometer plate. Observations were made in temperature regions between 20 and 650 deg. C. on 32 different kinds of glass. Their dimensional changes are represented by curves reproduced in the report which show that the glass passes through a critical expansion region in which the expansion rate increases by two to seven times. This critical region, which for any one glass does not exceed 40 deg. C. was found as low as 400 deg. C. with some samples and as high as 575 deg. C. with others. About 75 deg. C. above the critical region the glass softens and contracts. A comparison of results show that the heat absorption observed by other experimenters occurs in the same temperature region as the critical change in the expansion.

From these determinations of the dimensional changes of glass the following information is obtained: The thermal expansion above and below the critical temperature, the temperature for most careful and thorough annealing, the upper limit for rapid annealing, and the region where careful cooling is essential. Many curves and sets of tables included in the report set forth in detail the numerical results obtained in the various tests.

REMOVABLE LIGHTING FIXTURES FOR RESIDENCES.

Manufacturers, Dealers and Householders Would Benefit by Development of Removable Fixtures of Practical Design.

By V. D. Green,

Publicity Manager, National Council of Lighting Fixture Manufacturers.

The suggestion that lighting fixtures should be so made that any layman can attach and detach them in a few moments is one which makes a strong appeal to every manufacturer, dealer and contractor in the fixture field as well as to the customer himself. The very word "fixture" implies something immovable—something which is as much a part of the house as the wiring itself. There is, however, no logical reason why a stand lamp which connects to a base board plug should be easily removable and a chandelier or a wall bracket should require the time of a fixture hanger with a kit of tools to take it down from its original position. The National Council of Lighting Fixture Manufacturers has been prompt to appreciate the possibilities of a quick attachable fixture and is recommending the idea to the earnest consideration of its member firms. Already ingenious devices have been registered by various inventors, and, doubtless, before long the average householder will regard the new type of fixture as an essential feature in any well-appointed home.

There are many advantages to be derived from portable fixtures from the householder's point of view. As a nation we are growing less and less inclined to settle permanently anywhere. At the same time our artistic sense is becoming steadily more and more developed, and the monstrosities in the way of furniture and lighting which satisfied the aesthetic desires of the last generation are fast being relegated to the junk pile. Every householder wishes his lighting furniture to harmonize with his other possessions which surround it, but, as a rule, the speculative builder is not troubled with any artistic yearnings of this nature. He is in business

to make money, and since it is seldom that more than 1% of the total construction cost of a building is reserved for fixtures these are frequently of the cheapest and most unattractive kind.

Many Fixtures Would Be Replaced if Convenient.

Were it practicable to change these misfit artistic efforts there is but little doubt that thousands of householders who are now living in painful association with lighting fixtures of jarring finishes and designs would cheerfully invest in one or more of the many beautiful creations which are now obtainable. At present, however, the fact that under many state laws the landlord can claim anything which cannot be removed without interference with the wiring or other parts of the house structure renders the average tenant chary of spending money for the benefit of someone else. Moreover, the difficulty of reconnecting without calling in professional assistance, and the instinctive dislike of the housewife to having workmen in the home, acts as another powerful deterrent to the purchase of individual fittings.

To the electrical contractor the removable fixture, if one may give it so contradictory a name, offers a new and as yet unexplored field. All contractors and dealers know the difficulty which their customers encounter in choosing a fixture unless it can be seen in the surroundings with which it must harmonize. Slight differences of finish and design unnoticed when the fixture is seen in the store often prove positively irritating after installation. The dealer is in no way to blame, yet the customer has often a vague feeling of dissatisfaction which is bound to react unfavorably in the long run on the contractor's business.

Under the new system the customer will select his fixtures and take them home with him just as he now takes home his lamps. If the effect is not precisely what he wants at the first trial he has at least gained some idea of what he does want and he can thus finally decide upon the one type of fixture which will give him the result desired. Another point, and one which is of no small importance to the dealer, is that the new system enables fixtures to be sold on a cash basis apart from the wiring job itself—a procedure which is seldom practicable where the fixtures are really a part of the wiring installation from the customer's point of view. The advantages of thus being able to get quick returns on one item of the installation, the cost of which is often a large proportion of the total contract, is one which the dealer and contractor will be quick to appreciate. For the reasons already pointed out there are thousands of people who would purchase fittings were it not for the expense and inconvenience of installing them. Few householders have anything to do with the mysteries of electric wiring, and fewer still are capable of making safe or reliable joints, but anyone can push a plug into its place.

The ease with which fixtures could be taken down for cleaning would probably lead to the dealer and manufacturer benefiting in another way. Practically every housewife delights in having her house spick and span, and if the ceiling and wall fixtures could be readily removed it is certain that she would be just as anxious to have them repolished and relacquered during the spring cleaning season. The wholesale dealer would benefit by the increased prosperity of his contractor customers. He would, moreover, be able to standardize his lines and thus handle fewer patterns. The reason why most householders are fussy and hard to please when selecting fixtures, is attributed to the fact that they realize that, under present conditions, when a fixture is once installed it is up for good. When it is possible to try one or two alternatives in a few minutes there is no longer the feeling of finality about the choice, and the customer will most likely accept the standard design without objection. For the same reason the manufacturer will benefit through the elimination of many freak and slow-moving designs. The central-station company will benefit also. "Hang your fixture like a picture" is a slogan which will give another talking point on the advantages of electricity over gas.

It is also possible that the fire-insurance companies would welcome a system which eliminates the possibility of loose joints at the very point in the wiring of a house where a defective joint is most objectionable. A good plug is preferable to a defective joint any time. But, if the quick-attachable fixture is to be introduced, attachments and plugs should first be fully standardized. The National Council of Lighting Fixture Manufacturers is bending every effort towards standardization of electrical details of this kind and it would be unfortunate if the new system were to be killed by the use of noninterchangeable attachments.

AN ELECTROLIER FOR EMERGENCY PURPOSES.

At Ocean Park, Cal., an electrolier, shown in the illustration, is kept on hand for emergency purposes. In case one of the regular street-lighting standards is removed for repairs or in case of an accident to one of them, the substitute unit is used. It consists of a large sawhorse which supports an upright pipe, at the top of which a lamp is placed. The wires run down the pipe and are arranged for connection in the same manner as the ordinary lamp standard. It is frequently called into service.

Temporary Lighting Standard for Use in Cases of Emergency.

EDITORIAL COMMENT

Economics of Poor Lighting

Many apparently successful business men have peculiar ideas relative to efficient lighting methods, as may be observed in traveling from place to place and discussing the subject with various individuals and executives. Cheapness often appears to be the first consideration in lighting efficiency, cheap fittings and inadequate illumination being used in many places where better and more liberal provisions would more than pay for their cost aside from the added comfort and convenience of their use. It is not unusual to find the poorest kind of fixtures and the most inadequate illumination on the desk of a business man who demands the very best of provisions obtainable in his home.

It may be proper to equip an office or workroom in a simple and inexpensive manner for reasons of economy, or to provide the maximum contrast of comfort in the home, but there can be no reason or excuse for insufficient or improper provisions of lighting or equipment. The business man and his employes may be required to work under artificial light in the office or shop for the entire day, while at most only three or four hours are spent under such conditions in the home. If, because of improper or insufficient illumination in the shop or office, the worker returns to his home exhausted and in low spirits, the better surroundings of the home will lose much of their value. The vitality wasted through an entire day cannot be restored by the substitution of suitable conditions for a short period.

Light is now being given much more consideration than in the past in connection with the problem of production, and the subject is well worth considering from the purely commercial standpoint of immediate gains. It is invariably found that good lighting pays handsome dividends on its cost wherever substituted for insufficient or improper illumination. These dividends accumulate through the reduction of accidents to employes, reductions in spoilage in materials and finished products, actual increases in the total output of product whether in manufactured goods or office work, and through the general improvement in morale of the entire organization. The labor turnover is much reduced in a well-kept and wholesome plant over that prevailing in a dingy, unsightly establishment, and there is no other factor more important than light in transforming a dirty and ill-kept property into a comfortable plant.

Thus it is evident that good lighting is not an extravagance, but rather an economy, and a brightly lighted office or workroom is an evidence of thrift. In the light of investigations that have already been made, there is no justification for further delay in correcting the conditions still prevailing in many places. Sufficient thought and study have already been given to the question of good illumination to point out the direction in which the greatest improvements may be made in a short time, and the industry should bend every effort toward progress along these lines. What the future may bring is as yet not fully determined, but it is plainly evident that the old conditions are wasteful and must be supplanted. Improvements now available can be easily justified so that there is no excuse to wait for further advances in the future. The lighting industry is almost in duty bound to offer and insist upon the use of its present wares.

Creating a Demand for Good Lighting

One of the most significant facts pointed out at the recent convention of the Illuminating Engineering Society was the necessity of further effort toward the education of the public to the advantages of good illumination. The need for artificial light when natural light fails has always existed. It is a necessary adjunct to human endeavor, safety, convenience and comfort, and in spite of the urgent demand for good lighting, the present standards have only been reached after many years of development.

During the last quarter of a century more progress has been made than during any other period. Improvement has come so fast that the public, accustomed to the poor artificial lighting, is having difficulty in coming to a full realization of the possibilities and benefits to be gained by the use of modern illuminants. There is a great deal of inertia on its part, owing to the lack of knowledge. This inertia must be overcome, a task that is in the hands of the electrical industry.

The program of education announced by the Illuminating Engineering Society is even far more commendable than it seems, for the ultimate benefits to be gained by the public at large cannot be estimated. Impetus to the movement has been given by the Society, its plans are broad and constructive, and we hope every branch of the industry will contribute its support, so that a universal demand for good lighting will be created.

THE WEEK'S NEWS

Reports of Important Meetings, Developments and Other Happenings of the Electrical Industry and Its Allied Interests

ELECTRICAL CREDIT ASSOCIATION TO MEET NEXT MONTH.

Accounting Systems, Uniform Trade Terms and Other Important Subjects Down for Discussion at Twenty-fifth Annual Meeting.

The twenty-fifth annual meeting of the Electrical Credit Association of Chicago will be held in the Congress Hotel, Chicago, Dec. 9-10. The first day will be devoted to discussions on various subjects, the leaders in the discussions and the topics being as follows: "The Trend of the Times," Horace A. Lewis, New York City; "Trade Acceptance Experiences and Results," E. W. Shepard, New York City; "Credit Insurance," F. Willard Smith, Chicago; "The Square Deal for the Electrical Credit Association," S. R. Fralick, Chicago; "Value of Electrical Credit Association Membership," J. D. Meek, Indianapolis, Ind.; "Contractors' Standard Accounting System," T. K. Quinn, Cleveland; "C. O. D. Refusals," H. L. White, Detroit; "Uniform Trade Terms," A. Lapin Cohen, Detroit, and J. S. Mogenson, Chicago; "Credit Problems in the Cotton Belt," C. Robert Churchill, New Orleans, La.

The business meeting of Dec. 10 has been designated as an "open parliament" session, at which the following subjects will be discussed: Association experiences and results; constructive credit granting in critical times; systematic collection methods; mercantile agency service; expanding the Electrical Credit Association service; collection agencies vs. Electrical Credit Association system, and other subjects introduced by members. Model credit and collection forms will be exhibited and studied. The session will conclude with the presentation of the various committee reports.

INDUSTRIAL LIGHTING DEMONSTRATIONS TO BE ADVERTISED.

Non-Technical Lighting Advertising Committee and Cities Where Demonstrations Will Be Conducted Are Given.

The work of installing permanent lighting demonstrations in 31 of the principal cities of the country is carried on by a special lighting committee, newly formed by the National Electric Light Association, and under the auspices of the Lighting Sales Bureau, Ward Harrison being the field representative for this work. Oliver Hogue, chairman of the bureau, has requested the non-technical lighting advertising committee to act as the publicity agency to keep interested parties in touch with the lighting program, as well as advising them of the progress of the work from time to time. It is felt that the results obtained by local interests from the many permanent exhibitions as they are put on, will do a great deal to stimulate the educational and developmental work of this nature in the electrical industry within the next few years and benefit the central-station companies, manufacturers, dealers and jobbers.

The following is the personnel of the non-technical lighting committee and the cities in which each member will have charge of the lighting demonstrations:

Kansas City, Omaha and New Orleans—N. B. Hickox, National X-Ray Reflector Co., Chicago.

Milwaukee and Minneapolis—P. A. Powers, Benjamin Electric Manufacturing Co., Chicago.

Indianapolis and Detroit—E. J. Stahl, George Cutter Works of Westinghouse Electric & Manufacturing Co., South Bend, Ind.

Buffalo, Erie, Pittsburgh and Rochester—D. T. Laylin, Adams-Bagnall Electric Co., Cleveland.

Cincinnati, Cleveland and Louisville—F. J. Baschke, Nela Park, Cleveland.

Atlanta, Birmingham and Philadelphia—T. J. McManis, Edison Lamp Works of General Electric Co., Harrison, N. J.

Baltimore, Brooklyn, Newark and New York—F. W. Prince, Westinghouse Lamp Co., New York City.

Boston, New Haven and Providence—Julius Daniels, Edison Electric Illuminating Co. of Boston.

Chicago, St. Louis and St. Paul—Dana Howard, Commonwealth Edison Co., Chicago.

San Francisco, Los Angeles, Portland, Seattle and Pacific Coast cities—L. E. Voyer, General Electric Co., San Francisco.

PUBLIC POLICY COMMITTEE, N. E. L. A., HOLDS CONFERENCE.

Financial Interests and Representative of Gas and Electric Railway Industries Discuss Various Phases of Public Utility Problems.

Investment bankers, manufacturers, business men and representatives of the American Gas Association and the American Electric Railway Association attended an open meeting of the public policy committee of the National Electric Light Association at national headquarters in the afternoon of Nov. 4, at which time different phases of the present public utility situation were discussed. The following attended: O. B. Willcox Bonbright & Co., New York City; Randal Morgan, P. H. Gadsden and Walton Clark, United Gas Improvement Co., Philadelphia; Frank W. Frueauff, H. L. Doherty & Co., New York City; Harrison Williams and F. L. Dame, Central States Electric Corp., New York City; John E. Zimmerman, Day & Zimmerman, Philadelphia; H. M. Addinsell and C. W. Beall, Harris Forbes & Co., New York City; P. G. Gossler, A. B. Leach & Co., New York City; Thomas W. Martin, Alabama Power Co., Birmingham, Ala.; J. K. Newman, Ladenburg Thalmann & Co., New York City; E. K. Hall, American Telephone & Telegraph Co., New York City; George Burr, Guaranty Trust Co., New York City; George W. Bacon, Ford, Bacon & Davis, New York City;

E. W. Rice, Jr., General Electric Co., New York City; R. E. Breed and George N. Tidd, American Gas & Electric Co., New York City; G. B. Cortelyou, Consolidated Gas Co., New York City; E. N. Sanderson, Federal Light & Traction Co., New York City; Arthur Williams, New York Edison Co., New York City; C. E. Groesbeck, H. H. Crowell and F. B. Odlum, Electric Bond & Share Co., New York City; Charles W. Price, Electrical Review Publishing Co., New York City; James McGraw and W. H. Onken, McGraw-Hill Co., New York City, and H. T. Sands, Edison Electric Illuminating Co., Boston.

This conference was preceded by a meeting of the public policy committee, Chairman S. Z. Mitchell presiding. Present activities of the association were discussed. It was recommended that President Martin J. Insull appoint a committee to co-operate with other public utilities in presenting public policy matters to the public. President Insull, Executive Manager Aylesworth and S. Z. Mitchell were appointed to represent the National Electric Light Association at the Washington conference of the National Association of Railway and Public Utilities Commissioners.

The following were in attendance at the committee meeting: President Martin J. Insull; Vice-presidents M. R. Bump, Frank W. Smith and Walter H. Johnson; Treasurer H. C. Abell; S. Z. Mitchell; H. G. Bradlee; Charles L. Edgar; W. W. Freeman; Samuel Insull; John W. Lieb; J. B. McCall, chairman, finance committee; T. E. Murray; Guy E. Tripp; O. D. Young; J. E. Davidson, chairman, Public Relations National Section; M. H. Aylesworth, executive manager.

HEAT TREATMENT DISCUSSED AT A. I. S. E. E. MEETING.

At the Nov. 6 meeting of the Philadelphia section, Association of Iron and Steel Electrical Engineers, G. P. Mills, Electric Furnace Construction Co., Philadelphia, gave a lecture on "Electric Heat Treatment," in which he brought out some pertinent points of interest to present and prospective users of electric furnace equipment.

GOOD-WILL ADVERTISING CAMPAIGN PROGRESSING.

A meeting of the manufacturers' good-will advertising campaign committee of the National Electric Light Association was held at the association headquarters in New York City on Nov. 9. P. L. Thomson, Western Electric Co., chairman of the committee, reported an encouraging response from electrical manufacturers to the request that each manufacturer devote part of his advertising space to developing good-will toward the public utilities and the entire electrical industry by presenting interesting facts to the public. A particularly encouraging feature of the replies was the evident desire on the part of many small electrical manufacturers to co-operate in the work whether they were advertisers or not.

The committee is now formulating plans for a campaign of concerted action by the manufacturers through their national popular magazine and trade paper advertising and preparing, through house organs, distribution of booklets and other sources, to carry on the work among the electrical industrial organizations. All manufacturers desiring to participate in the campaign will be shown definite ways and means of promoting the work.

POWER PLANT READY FOR SERVICE IN TEXAS OIL FIELDS.

Construction of the dam across the Leon river, three miles from Eastland, Tex., by the Oil Belt Power Co. for the purpose of impounding water to operate its hydroelectric plant has been completed. The capacity of the new plant is 10,000 hp. and this will be increased as the demand for power may justify. About $5,000,000 has been expended on the project, according to J. E. Lewis, general manager of the company. The output of this plant will be transmitted throughout the oil fields of central west Texas and used to pump wells and possibly to drill wells. Demonstration has proved that the wells give a larger yield of oil under the electric system of pumping than by any other method.

INDUCTIVE INTERFERENCE PROBLEMS IN WESTERN STATES.

Complete Program to Be Discussed by Inductive Interference Committee at Salt Lake City Meeting Next Week.

In last week's issue it was announced that W. J. Canada, representing the engineering department of the National Electric Light Association, is investigating and discussing with representatives of member companies in the western states certain phases of inductive interference, overhead line strength and similar matters. In a report to national headquarters, Mr. Canada states that he conferred in Chicago with Frank F. Fowle, inductive interference consulting engineer, regarding the extension of the association's activities on the inductive interference problem from both its technical and mechanical side. The work will be under the guidance of and with the assistance of the inductive interference committee, and the complete program will be discussed at a meeting of that committee in Salt Lake City, Utah, Nov. 15.

Heretofore study has been mainly devoted to the disturbing features of inductive fields produced by power circuits and to the means for their reduction, rather than being directed towards minimizing the susceptibility of communication apparatus. It is now planned to develop studies of the susceptibility of communication systems to the inductive fields of power circuits and also of means for minimizing this susceptibility.

STANDARDIZATION TOPIC OF GEAR MANUFACTURERS' MEETING.

Standardization was the keynote of the fall meeting of the American Gear Manufacturers' Association held at Mohonk Lake, N. Y., Oct. 27-29. The subject was approached from all angles in the reports of the various committees and subcommittees of the association, as well as speakers from outside the organization. P. G.

Agnew, secretary of the American Engineering Standards Committee, spoke on "Standardization from the Point of View of the American Engineering Standards Committee"; Calvin W. Rice, secretary of the American Society of Mechanical Engineers, gave a talk on "Standardization"; C. L. Collens, president of the Reliance Electric & Engineering Co., and past president of the Electric Power Club, made an address on "Industry Organization," and Christopher Haigh, General Electric Co., presented a paper on the "Machine Rate Method of Distributing Expense."

INDEPENDENT LAMP MANUFACTURERS FORM ASSOCIATION.

Independent manufacturers of incandescent lamps, together with a number of manufacturers of allied equipment and accessories, have organized an association with headquarters at 8 Bergenline avenue, Union Hill, N. J. It is planned to improve the conditions of co-operative buying and selling, and to establish a research engineering and development laboratory for the members. In addition, it is proposed to standardize lamp products and to keep members informed of improvements in the manufacture as well as to hold meetings for the exchange of ideas and reading of reports. The officers of the association are: President, Nicholas Fabian, Continental Lamp Works, New York City; treasurer, Frank Alexander, Alpha Lamp Co., Harrison, N. J.; secretary, Charles B. Levy, American Auto Lamp Co., New York City.

NEW YORK SECTION, I. E. S., HOLDS MEETING.

A talk by Ward Harrison, illuminating engineer of the National Lamp Works of General Electric Co. and field director of the lighting department, National Electric Light Association, on "Industrial Lighting" was the feature of a joint meeting on Nov. 12 of the New York Section, Illuminating Engineering Society and members of the Electrical Supply Jobbers Association. Actual demonstrations of industrial lighting, showing various systems of illumination and pointing out the right and wrong ways in the application of light, were given in connection with Mr. Harrison's address. The meeting was held in the auditorium of the New York Edison Co., 44 West 27th street, New York City.

INSTITUTE PLANS MEMORIAL EXERCISES FOR DR. SHELDON.

Memorial exercises for the late Dr. Samuel Sheldon, professor of electrical engineering and physics at the Polytechnic Institute of Brooklyn since 1889, past-president of the American Institute of Electrical Engineers and well-known scientist, will be held Wednesday evening, Nov. 17, in the auditorium of the Engineering Societies building, 33 West 39th street, New York City. The exercises will be presided over by Arthur W. Berresford, Polytechnic Institute '92, president of the American Institute of Electrical Engineers, and addresses will be made by William N. Dickinson, Bancroft Gherardi, Arthur E. Kennelly, T. Commerford Martin and William H. Nichols. The committee having the affair in charge is under the chairmanship of Mr. Martin and is composed of professional associates of Dr. Sheldon and representatives of the Polytechnic Institute from the corporation, faculty, alumni and student body. Erich Hausmann, of the Polytechnic Institute, is secretary.

COMMITTEES MAKING PROGRESS ON SAFETY CODE PROGRAM.

The safety code program being drawn up by a number of organizations under the auspices of the American Engineering Standards Committee is making progress. Following the regular procedure each code is being formulated by a sectional committee, organized by one or more bodies designated for the purpose by the American Engineering Standards Committee and known as sponsors. The latter are representatives of the interests concerned. Among the sponsorships for the additions to the safety code which have been arranged for are the following: Lightning protection, American Institute of Electrical Engineers and the Bureau of Standards; lighting code, Illuminating Engineering Society; electrical fire code, National Fire Protection Association; electrical safety code, Bureau of Standards; construction work, National Safety Council.

POWER PRODUCTION OF UTILITIES IN AUGUST.

The public utility power plants in the United States produced during August, 1920, 1,410,831 kw-hrs. of electricity by water and 2,294,353 kw-hrs. by fuels, according to a report issued by the United States Geological Survey. For this purpose it required the combustion of 3,010,173 tons of coal and 1,090,883 bbls. of fuel oil.

COMING CONVENTIONS.

Electric Power Club. Fall meeting. Hot Springs, Va., Nov. 15-18. Headquarters, Homestead Hotel. Secretary, C. H. Roth, Adams and Loomis streets, Chicago.

Electrical Supply Jobbers Association. Semi-annual meeting, Cleveland, Nov. 17-19. Headquarters, Hotel Cleveland. Secretary, Franklin Overbagh, 411 South Clinton street, Chicago.

Southeastern Geographic Division of the National Electric Light Association. Annual convention, Miami, Fla., Nov. 16-19. Headquarters, Urmey Hotel. Secretary, Charles A. Collier, Atlanta, Ga.

Jovian Order. Annual convention, St. Louis, Nov. 25-26. Headquarters, American Hotel Annex.

Indiana State Electrical Contractors and Dealers' Association. Annual meeting, South Bend, Ind., Dec. 1-2. F. H. Shumaker, 902 South Michigan street, South Bend.

American Institute of Chemical Engineers. Winter meeting, New Orleans, La., Dec. 6-9. Headquarters, St. Charles Hotel. Secretary, John C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

Illinois State Electric Association. Annual convention, Chicago, Dec. 9. Headquarters, Hotel La Salle. Secretary, R. V. Prather, Springfield, Ill.

National Council of Lighting Fixture Manufacturers. Annual convention and lighting fixture market, Elmwood Music Hall, Buffalo, N. Y., Feb. 14-19. Secretary, Charles H. Hofrichter, 8410 Lake avenue, Cleveland.

American Institute of Electrical Engineers. Annual convention jointly with the Pacific Coast Convention, Salt Lake City, Utah, June 20-25. Secretary, F. L. Hutchinson, 33 West 39th street, New York City.

COMMERCIAL PRACTICE

New-Business Methods, Policies, Rates and Kindred Central-Station Matters for the Man Engaged in Selling Electricity

ELECTRICAL GIFTS FOR CHRISTMAS FEATURED BY N. E. L. A.

The National Electric Light Association has prepared and distributed to its members a Christmas booklet entitled "Electrical Gifts," illustrating in an attractive manner an interesting assortment of electrical devices suitable for presents at the Yuletide season. Stress is laid on the fact that electrical gifts combine the practical with the beautiful in a manner befitting any occasion. The economy, practicability, usefulness and attractiveness evidenced by their daily use are perpetual reminders of the good judgment of the giver through the many long years of their life. A 1920 Christmas folder has also been designed for members of the N. E. L. A. to be inclosed with all correspondence and other mailing matter distributed between now and Christmas time.

DOHERTY ORGANIZATION INITIATES "BETTER LIGHTING" IDEA.

Demonstration Tour to Cover 23 Cities for Purpose of Interesting Business Men in Value of Better Lighting.

The recently formed business department of the Henry L. Doherty Co., New York City, has initiated a new idea in central-station commercial practice. This is known as the "Doherty Tour," under the immediate direction of George Williams, manager of the business department, and is being operated in co-operation with the Bryan-Marsh Lamp Division of the National Lamp Works of General Electric Co. The tour will include the 23 cities in which the Doherty organization operates central stations. Its purpose is the conversion of business men to the gospel of better lighting by "seeing is believing" demonstrations. One week's time is spent at each property and the tour will extend into late spring. A portable lighting exhibit is installed in each city that all may see the difference between good and bad lighting. An illumination engineer accompanies the demonstration and gives professional advice on practical lighting problems. The exhibit is modeled after the one used at the Pasadena convention of the National Electric Light Association.

The program each week includes four meetings and demonstrations, specific problems of separate groups being taken up each time. The first evening of the week is for the benefit and enlightenment of the local Doherty organization, executives, salesmen, and central-station men. On the following evening local electric interests —contractor-dealers and jobbers—are invited guests. Local manufacturers are invited to attend the demonstration the third evening, and the following night is for the benefit of the merchants of the city. A fifth evening is available for any special group that may be interested, or for follow-up work.

Toledo was the first itinerary on the tour and there the week of Oct. 18 the lighting program was carried out without a hitch. A special demonstration was put on the first night for the benefit of the factory management class of the Toledo University. Later in the evening the scheduled program was given for the local organization. The keen interest of the Toledo business men in the exhibit was typified at the Wednesday evening meeting when one manufacturer came forward at the end of the meeting with a rough plan of his factory and asked for technical data on the subject of better factory lighting. To A. K. Young goes much of the credit for the

Group of People Who Attended the Doherty Tour "Better Lighting" Demonstration at Toledo, O.

success of the Toledo meeting. Mr. Young, who is the new-business manager of the Toledo Railway & Light Co., is sponsor for the initial exhibit of the Doherty tour.

CENTRAL-STATION IMPROVEMENT OF FACTORY LIGHTING.

Experience of Massillon (O.) Electric & Gas Co. Given in Paper Before Illuminating Engineering Society.

By J. B. Wilson.

It has been proven with absolute certainty that everyone prefers good illumination whether it be in the home, office or factory. But how many factories or industrial plants today have a modern lighting system? For example, will the average manufacturer when planning the erection of a new plant, or an addition to his present plant, give lighting the consideration it should have? It has been our experience that in almost every instance the material to be used for erection, the kind of machinery to be installed, etc., will be given most careful consideration, but very little thought will be given to lighting. In most cases the lighting is turned over to an electrical contractor whose interest centers principally in wiring and equipment and who will place outlets as he thinks best for general illumination.

In the past we have criticized the general manager or the one in charge of the plant for not giving lighting more serious consideration. We have criticized the electrical contractor or the architect for not laying out or specifying a proper lighting installation. But have we been fair in this criticism? The general manager has a million and one things to think about and will naturally turn electrical work over to someone in his plant or to a contractor who is interested only in the operation of the electrical equipment in the plant. The average contractor, architect or electrician has not as yet been sufficiently educated in the matter of illumination and is therefore not in a position to render a lighting service in the full sense of the word. To even the architect or the factory superintendent, the matter of foot-candles, lighting intensities, etc., is so much Greek. There is an obvious responsibility which someone should assume in each community for carrying on lighting educational work. Every central-station company sells light and therefore this responsibility naturally falls to its lot.

During January, 1920, we had a survey made of the lighting situation in Massillon, O., and vicinity, and after the subject had been discussed with several of the industrial heads it was found that it would take months to bring the industrial lighting standard in that city up to the proper plane, both quantitatively and qualitatively, by the more or less slow method of trial installation. The application of this method in every industry in the city was prohibitive from the standpoint of cost in money as well as time.

While we were casting about for a solution to the problem, we heard of a demonstration of industrial lighting at Nela Park—a demonstration in which a number of types of lighting are shown, the different steps in illumination design clearly pointed out, and the advantages of good illumination both seen and felt. This seemed to offer the solution of the problem. Arrangements were made to take a number of the factory heads to see this and other demonstrations at Nela Park and to spend the day in studying lighting. We believed that if this program could be carried out, we would accomplish in a day what would ordinarily take years.

Invitations were extended to the men in the different industries, and on the day of the excursion, 37 were present. A full day was devoted to discussions and demonstrations of lighting with the industrial lighting demonstration forming the climax of the day's program. The details of this day's program are not of particular interest at this time, but it is of interest to know that even men 65 to 70 years old said they had been taught more about illumination in six hours than they had learned in their lifetime before. There was nothing in the day's program which could in any way be construed as an effort to sell anything or to induce anyone of the party to make changes in his plant. The trip was a pleasure trip with education as its objective and not a business trip in the ordinary sense of the term.

Central-station representatives will be interested in the fact that the total cost to us of this trip was $128, which we charged to advertising, and as to whether this was a profitable advertising expenditure, we will let the figures cited later decide.

The following day the manager of the Enterprise Aluminum Co. called us on the telephone and asked if we could send one of our men to look over a lighting system which was just being installed. Arriving at this plant, we found that the lighting had some time before been turned over to a contractor with instructions to install a complete system. They were installing glass reflectors with 100-watt clear Mazda C lamps and were getting 1.2 foot-candles on the working plane. When we had made different recommendations the head of the plant said that he had realized the minute he got back that they were installing the wrong equipment and that it would be a matter of only a short time before they would feel the necessity for changing over the entire system. He, therefore, accepted our recommendations, ripped out the entire installation, and had his own factory electrician install the lighting system we laid out. In this plant we recommended RLM reflectors with 200-watt bowl-enameled lamps. After this installation was completed, an intensity of 14 foot-candles was obtained, with an increased wattage of 53.4 kilowatts.

A few days after our return from Cleveland, while talking to the superintendent of the Massillon Foundry & Machine Co., I noticed several men working in the shop painting the side walls, cleaning lighting fixtures, etc. The superintendent asked me what I was smiling at and I told him that our trip a few days before must have made an impression. He had given instructions to have the side walls painted a light color and had appointed two men in the shop to see that the lighting fixtures were cleaned weekly.

Among other examples is the Peerless Drawn Steel Co., which operates one of Massillon's

largest steel plants and which had been using tin reflectors, 200 and 300-watt Mazda lamps, 60-watt carbon lamps, etc., throughout the entire plant. We have just completed an installation of eighty-nine 750-watt lamps with RLM reflectors. Within the past three months, the wattage in this plant has been increased 105 kilowatts. The head of the plant stated that the results have been so satisfactory he intends relighting the entire plant. In this plant an intensity of 15 to 16 foot-candles is obtained.

Demonstration of Lighting Fixtures Triples Lamp Sales.

A few comparisons will be of particular interest to the man interested in central-station sales. From January to July, 1919, inclusive, we added in industrial lighting 68.5 kilowatts. During the same period in 1920 we added 431 kilowatts. The added kilowatt load in lighting for 1919 used on an average of 5 hours a day or 150 hours a month, would yield an added revenue of $10,800 a year. With the increased wattage of 1920, figuring the increase on the same basis, it would yield a net revenue of $62,964 a year. During the first seven months of 1919 we sold 39 fixtures for a total of $535.72, with a profit of $185.81. For the first seven months of 1920 we sold 1063 fixtures for the sum of $6016, with a net profit of $985. It can easily be seen from the experience we have had that it pays the central station to go after the lighting business. I remember a year or more ago that, when the lighting question was taken up with us by one of our New York officials, I stated that the lighting opportunities in our vicinity were very small as every factory I knew of had its own electrician, bought its own fixtures at wholesale, and that we had very little chance of breaking in; also, that we had run lighting campaigns on commercial fixtures for the past several years and that every store in the city was pretty well equipped. But since we have gone after industrial lighting, I can easily realize that this New York official had given the matter more thought than we had.

After going into the lighting situation, it has been proven that electricity is not only in its infancy, but industrial lighting has just begun. What prevailing intensities will be five years from now is largely a matter of conjecture, but there are not lacking reasons for predicting that ranges of intensities far beyond what we are thinking of today will come into use. Being fully convinced of the value of demonstration as a means of selling the better lighting idea, we have installed in one of the rooms of our offices a small installation showing types of industrial reflectors, lamps, window reflectors, etc. The entire cost of this demonstration has been approximately $60. We find it much easier and more economical to demonstrate to a man what we are recommending than to make trial installations.

In the past seven months we have more than tripled our lamp sales and we also find that we are getting away from small lamps. In most industries that had been using 25, 40 and 50-watt lamps over their benches, these small lamps have been eliminated and in but very few cases we are now recommending new lamps smaller than 100 watts.

I sincerely believe that every central-station company, contractor, architect or anyone interested in lighting work should have a foot-candle meter. For three months we have had a lighting meeting two nights a week with our entire sales force, and we feel that any one of our salesmen can lay out a lighting installation without any difficulty. We have brought the architects and the electrical contractors in our vicinity into our fold, so that they are bringing their plans to our office to have the lighting laid out. The question has been brought up by various central-station men that they do not sell fixtures or do wiring. I might say in this instance that we do no wiring of any kind, house wiring or commercial, but turn this work over to some contracting company. We make the lighting layout on their blueprints and get an estimate from the contractor for doing the work, but in most cases we find the industrial plants have their own electrician and all we need to furnish are reflectors and lamps.

In Massillon proper, we have approximately 52 plants which could be termed factories or industrial plants. Of this number, we have installed complete lighting systems in seven and are working on nine more. We have also been requested to make lighting layouts for eight others.

I might say in conclusion that through this lighting work we have become better acquainted with the working heads of the industrial plants. There is a fine feeling of mutual satisfaction because we feel and they feel that we have rendered them a distinct service by giving them ample illumination properly laid out.

UTILITY SECURITIES WELL TAKEN BY EMPLOYES.

Advices from Rock Island, Ill., indicate that 550 employes have subscribed for over $165,000 of stock in the local utility companies, or an average investment of $300 on the part of each. All are employes of the Peoples Power Co., Peoples Light Co. and the Tri-City Railway Co., which supply gas, electric and railway transportation in the quad-cities. They recently were offered the opportunity of becoming partners in the business through the purchase of stock of the management company, the United Light & Railways Co. There are now nearly 300,000 residents of Illinois who are owners of utilities securities.

PROSPERITY BRINGS DEMAND FOR FARM SERVICE.

In commenting on the increasing calls for central-station service on the farm, the Pacific Power & Light Co. *Bulletin* calls attention to the increasing prosperity of the farmer in a certain irrigation district of Washington. Figures were presented showing an increase of about 50% in the cultivated area of the district, accompanied by an increase of about 280% in the value of the harvest for the past five years. It is intimated that the farmer wants electric service and is willing to pay when he has the necessary money at hand.

CONTRACTOR-DEALER

An Exchange of Ideas and Experiences on Advertising and Selling Methods, and Store-keeping for the Dealer in Electrical Goods

CO-OPERATIVE ADVERTISING AIDS WASHER CAMPAIGN.

Manufacturer and Dealers Combine to Run Series of Advertisements in Cleveland Newspapers During an Autumn Sales Rally.

The illustration herewith shows the manner in which the Apex Electrical Manufacturing Co. is co-operating with the electrical contractor-dealers in Cleveland in an advertising campaign. The

Sample of Co-operative Dealer-Manufacturer Advertisement in Cleveland Sales Campaign.

"Rotapex" clothes washer is featured in the advertisements which appear in each daily paper once a week for three months.

Down the left side and across the bottom of each advertisement appear the business cards of nine contractor-dealers.

LIGHTING ART SERVICE SUPPLIED BY CONTRATOR-DEALERS.

Additional Profits to Be Made Through Campaigning to Popularize Decorative Lighting in Old Houses With Obsolete Fixtures.

One of the papers presented at a recent convention of the Illuminating Engineering Society at Cleveland contained the suggestion that any aggressive electrical dealer or central-station company doing a merchandising business could furnish a "lighting art service" to great advantage.

"The great bulk of the buying public has its back turned to the electrical dealer at present so far as lighting merchandise is concerned," said the paper, "but by advertising, store demonstrations, soliciting and circularizing we can gain entrance to many old houses and apartments."

It was advised that forceful advertising would implant the idea and advantages of better home lighting, while it invited inquiries with the promise that a representative would call with more definite information and prices. This representative could enlarge on the benefits of redecorating with light while emphasizing the fact that present fixtures and wiring could be left intact. He should also state definitely what could be done for $25, $50, $150 or whatever sum the householder might be induced to spend.

Any order for material so secured would be filled from a special stock set aside for this purpose in the electric store or shop. Such a stock would naturally include standard receptacles, shade holders, adapters and wiring devices. In addition there could be profitably carried such items as silk and parchment shades, shields and transparencies; harps, converters, holders and adapters for inverting glassware on ceiling fixtures, wall brackets and portables; glassware suitable for true semi-indirect lighting—to be used on inverted fixtures—to be of low brightness and attractive color tone; candlestick adapters, table-lamp adapters, wire shade frame for use where householders desire to make up their own shades; a line of silvered glass and porcelain enameled metal reflectors suitable for totally indirect lighting effects in the home; a line of urns, flower boxes and basket work, and a full line of portable lamps.

One dealer in Chicago who carries practically the above stock has figured that a $600 advertising campaign would lead to sales roughly estimated at $40,000. He is at present working up such a campaign. The belief was also stated that if the idea was sold to a hundred or so homes in any given city, those homes would become compelling object lessons to the neighborhood as well as to the central-station officials, architects, contractors and others who might be called in to view them, with the result that superior home illumination would very soon become a vogue.

ELECTRICITY ONLY SERVANT LEFT IN MODEL HOME.

Visitors at the recent electrical exposition held in New York City were greatly impressed with a display which showed a servantless household in which electric labor-saving appliances were being demonstrated to prove how well they could perform or greatly lighten the labor of every household task from laundry to nursery. This department was very successful in creating the impression that the only reliable general servant left is electricity.

Business Hints for the Dealer

Electrical Gift Certificates Suggested as Method to Minimize Holiday Confusion — National Exchange Between Dealers Possible

The average dealer in electrical merchandise witnesses the approach of Christmas with mixed emotions. The holidays bring a big and welcome volume of business, but they also bring so much stress that in most cases the dealer regards his Christmas profit as dearly won. His sales staff is overworked, and because of the nature of the season it is usually impossible to procure sufficient help to take proper care of the situation. Conditions are complicated by the demand of the public for all sorts of service. A man buying an electric lamp for his married sister in a distant city usually asks the dealer to prepare the article for shipment, and if the request is declined the patron may depart in an extremely bad humor.

Anything that will minimize the Christmas confusion and at the same time result in an added volume of business would, of course, be hailed with rejoicing by the trade, and the suggestion of a Middle-Western dealer in electrical goods will win favorable attention for this reason. This dealer used the gift certificate plan last Christmas with good results. His advertisements advised patrons who were buying gifts for local friends not to select the article, but to use the gift certificate plan which would permit the recipient to select his or her own gift. If a woman were buying an electric iron for a friend, for instance, the dealer suggested that the recipient probably would prefer to select the article herself and that it would be much more satisfactory for all concerned if the giver merely presented the friend with a certificate which the latter could present for redemption, making her own selection of an iron of the desired weight and type.

Using Gift Certificates to Modify Holiday Trade Rush.

This plan, as indicated, worked well and took a big burden off the selling staff. The business was more evenly distributed. It was a simple matter for a clerk to make out a gift certificate; much easier, in fact, than making the sale would have been. The week after Christmas, usually quiet in such stores, was a busy one in this establishment, many holders of gift certificates coming in to exchange the paper for the merchandise. The salesmen had plenty of time to handle the trade, and the method thus proved far more effective than the old way where all the holiday business was crammed into the few days prior to Christmas.

Where patrons were buying gifts for persons living in other cities, the plan could not be used, of course. But this dealer is convinced that a working agreement could be made by members of the trade so that each would have relations with at least one other like store in every city of importance in the country. In other words, he believes the gift certificate idea should be nationalized instead of being allowed to remain purely a local proposition.

There is something essentially inefficient in the idea of a man going into an electrical store in Chicago and buying an electric sweeper for his married sister in New York, for instance, while the sister in New York repairs to a similar store there and invests in a toaster for her bachelor brother's apartment in Chicago. Both parties to the transaction necessarily go to the trouble of preparing the gifts for shipment and also paying for the express or parcel post charges and insurance. With all of this, there is no guarantee that the gift will arrive anywhere around Christmas. The postoffice is so harassed during the holidays that a package sent on Dec. 20 is often delivered around Jan. 1. In addition, the gifts are not always satisfactory. The young woman often feels that she could have made a more discriminating selection of sweepers, while the brother would probably have preferred to choose his own toaster. Each knows less of the other's needs than of his or her own.

National Exchange of Gift Certificates for Electrical Dealers.

The whole problem could be simplified by such an arrangement as this dealer suggests. Instead of actually buying the merchandise, the man and woman in the instance cited would simply have invested in gift certificates and mailed them, thus saving express charges and work and insuring mutual satisfaction. The only loser would be the government, which in such a case would not have the work of transmitting the two parcels. However, it is probable that Uncle Sam would gladly forego this Christmas revenue, because of the fact that the additional work disorganizes the whole postoffice department and delays the regular mails.

Certificates issued by the Chicago dealer would be redeemed by his correspondent in New York, and the latter's certificate would be accorded the same treatment by the Chicago dealer. After the holidays, the recipients of the certificates would repair to the store designated and select the desired article according to their individual taste. Satisfaction to the recipient would thus be insured, particularly as the store's salesmen would have plenty of time after the Christmas rush and could devote proper attention to each patron. The settlement between the two dealers could be effected without difficulty. A check would wipe out any balance which existed on either side after the holiday trade.

Such an arrangement would not only result in the handling of the electrical business with a minimum of difficulty, but it would result in a larger volume of business of this kind. The public, properly apprised of the facilities placed at its disposal, probably would appreciate them to such an extent that, instead of giving jewelry or some other article which necessitated shipping, it would be glad to avoid this detailed work and expense and buy gift certificates from local dealers featuring the plan. This means, of course,

that more goods sold by electrical establishments would be used as Christmas gifts simply because it would be easy to make a gift of articles carried by such stores.

The plan would not be confined to Christmas trade, though it might reach its greatest usefulness at that time. The idea could be used throughout the year. If a man remembered in the nick of time that his sister or mother in another city were celebrating a birthday anniversary he could repair to the nearest store handling electrical goods and place an order for the gift he had forgotten. He could either secure a gift certificate and mail it to the person in the other town or have the dealer write his own correspondent there, who would deliver the gift on the designated day. If speed were essential the local dealer could telegraph his correspondent and the gift would be delivered the same day.

It is worth mentioning that this wiring of orders has proved highly profitable in the flower trade, not merely because flowers constitute a beautiful and appropriate gift, but because the florist is able to telegraph an order, thus helping business men and others out of an embarrassing situation when they have forgotten some occasion they should have remembered. It is singular that florists are the only business men who have arranged to come to the public's rescue in such cases, but not so singular that they have been well repaid for their foresight.

Of course, if electrical men were to adopt the plan indicated it would be necessary to educate the public on this point. This necessity offers no difficulties, since nearly all dealers in electrical goods are fairly big advertisers and the proposition is not so complicated but that it can be readily understood by everyone. There may be some disadvantages to the plan outlined, but the dealer who advocates it believes that its benefits will far outweigh the drawbacks. Universal adoption of the idea will mean less work and more business, in his opinion.

Taking Advantage of General Publicity Campaign for Holidays.

Contractor-dealers in every city in the United States will derive immense benefits from the general advertising campaign of the various manufacturers of electrical appliances and the helpful materials supplied by the Society for Electrical Development, provided they supplement these with a little local endeavor of their own. It has been planned to make an electrical Christmas this year. The general public is reading attractive advertisements in publications of national circulation suggesting that everybody this year "Say Merry Christmas Electrically." All that remains for the individual dealers in electrical appliances to do, to share generously in this big campaign, is to let their communities know where they may purchase the gifts with which to materialize the slogan.

In some cities where the electrical dealers are working together in a true co-operative spirit they are planning to take conspicuous space in the daily newspapers for which they will pay jointly, and in which their names and locations of their stores will appear. Some dealers who have established a large business are placing their individual display advertisements in the daily and Sunday papers at frequent intervals. In view of the influence this general publicity will have on the minds of the buying public it would seem that no electrical dealer can consider his business too small to reap a good profit from his local advertising.

Since the public has been thoroughly educated to depend upon advertisements for shopping information, in which the utmost confidence has been stimulated, the contractor-dealer cannot well afford to neglect that feature as a business builder. Carelessly, hastily or poorly constructed copy in a newspaper advertisement is, however, a wasteful way of doing business. No matter how small the space or how prominent its location, those experienced in advertising have proved that the most effective advertisement is that which has been constructed as the result of careful thinking and planning either by the head of the concern or by an experienced advertising writer.

In cities where the dealers form a co-operative advertising campaign they have found it most profitable to employ the services of a professional copy writer or advertising agency. Where conditions are such that the dealer must prepare his own advertising copy he can make it more effective by the use of simple language setting forth the fact that he is selling certain appliances because they are most proficient and inexpensive mechanical servants in the home. He should state the prices and terms conspicuously for each article advertised and include his business address in the copy. When the dealer lacks confidence in his own ability to prepare advertising copy and is not so situated that he can employ professional service, he can usually find something adaptable to his needs in the sample advertisements furnished by the Society for Electrical Development.

Having taken care of the newspaper advertising, the dealer will find it wise to use his mailing list of old and prospective customers. Personal letters are, of course, the most effective, but the mimeographed circular letter is seldom thrown away before reading by the recipient. Leaflets and booklets supplied by the manufacturer or jobber may be inclosed in the letters. Advertising, like any other essential commodity, costs money, but the outlay is one which can be depended upon to bring conspicuous returns.

SELLING LAUNDRY SERVICE RATHER THAN WASHING MACHINES.

Lack of Knowledge of Correct Washing Solutions Is Found to Be Frequent Cause of Failure of Electric Washers to "Stay Sold."

"Much of my success in the sale of electric washing machines during the past year is due to a little educational campaign which I conduct among my customers," said an electrical dealer in Chicago recently. "There are some other dealers who are now following the same plan with the best results since the Hurley Machine Co. has employed Mrs. Christine Frederick to supply service information which the dealer can furnish to his washing-machine customers."

This dealer said he frequently received complaints of failure of his washing machines to do

the work properly before he inaugurated his new plan. These complaints were tabulated and the dealer took the matter up with a representative of the manufacturer with the result that experiments were made and the problems solved. It was found by the manufacturer that the efficiency of the electric washer depends on the strength and kind of cleansing solution added to the wash water, the agitation of the water into foamy suds before the washing process was started, the time and temperature allowed for both washing and rinsing and a few other practices peculiar to the particular machine of this manufacturer.

In her information for the guidance of the dealers in giving service to washer customers Mrs. Frederick has pointed out that one of the most important steps in successful machine washing is the use of proper cleansing solutions. Dealers are advised to instruct the customer that the use of soap in solid or cake form must be discarded and that maximum efficiency is only obtained from the soap in the electric washer when the soap is cut up and dissolved so that every particle blends with the wash water. The clothes must not be soaped before they are put in the washer, nor must small bits of soap be permitted to get into the machine because they stick to the cylinder and finally adhere to the clothing as it is removed. It is best to shave and boil all bar soap slowly until the liquid is clear and of amber shade.

It is suggested that powdered soap saves the labor of cutting up and dissolves more quickly. Warning should be given customers against the promiscuous use of so-called washing powders. Mrs. Frederick says it is best to advise the use of the best grades of soap, to which the customer may add the desired amount of borax, soda or other grease-cutting substances. Careless use of washing soda, which is the strongest alkali, is advised against. For softening hard water the requisite amount should be carefully measured. If the water is soft it is safer to use borax, ammonia, kerosene, etc., for cutting grease without injuring the fabric.

Much other valuable information, together with recipes for washing solutions for various kinds of water and kinds and condition of the clothes to be washed, are furnished by Mrs. Frederick through the manufacturer, all of which is usable by the dealer in making sales to his customers. The Chicago dealer quoted above says that where one of his customers follows the instructions given, her success in the use of the washer induces her to act as an innocent sales maker among her neighbors.

COOKING APPLIANCES FOR THANKSGIVING WINDOWS.

Thanksgiving suggests prayer and feasting, with emphasis on the feasting, for the mistress who supervises the home commissary. To the housewife Thanksgiving usually means a busy week of advance preparation for the special dinner that marks this event in the American home. For that reason it was most appropriate that many contractor-dealers made a specialty of electric cooking appliances in their window displays for the occasion. Some dealers showed displays of electric stoves, grills, casseroles, chafing dishes, toasters and percolators. A few placed in their windows actual demonstrations of these table appliances. Many of the displays included an electric range. Showcards carried appropriate suggestions as to economy in time and labor.

SELLING POINTS THAT APPEAL TO THE WOMAN CUSTOMER.

Dealers Are Advised That Harm Often Results From Explaining Mechanical Features to Those Knowing Little of Mechanics.

In its advice to electrical contractor-dealers the General Electric Co. suggests the inadvisability, when selling vacuum cleaners, of dwelling upon the numerous mechanical advantages. "Such arguments are more harmful than beneficial," says the advice. There are a number of points, however, which the company says should be driven home. First, the labor-saving features should be emphasized; next, the handsome appearance of the appliance, and then, the company manufacturing it.

It is suggested that by stating that the Electric Vacuum Cleaner Co. employs over 600 people in a building containing 100,000 sq. ft. of floor space in which nothing but vacuum cleaners are manufactured, the salesman impresses women with the idea of stability. The dealer should sell his own reputation. He should repeat what other women have said who have purchased from him. The dealer should impress the fact that he maintains a complete service department, and that if anything goes wrong with the cleaner, he will have it repaired at once.

The woman who purchases any electrical household device does so because she has seen an advertisement that appealed to her, or her neighbors used one with great success and recommends it, or else she comes into the store and says she wants either a cleaner, washer or some other appliance, asking the dealer's advice as to which is best. It is therefore the duty of the dealer to sell her the best so that full satisfaction is assured the customer in its use.

ELECTRIC GIFTS FOR CHRISTMAS INCLUDE PERCOLATORS.

More electrical gifts will be purchased this year than ever before. For beauty of design and workmanship the modern electrical wares compare most favorably with the solid silver tea and coffee sets, with an added feature. The electric tea kettle is fitted with standard electrical heating element and a safety switch which automatically switches off the electricity should the kettle go dry. In the richly beautiful silver-plated coffee urn is represented the highest development of the art of electric hollow ware. The design is quite exclusive. Into these urns has been built the valveless percolating apparatus and the safety switch. They are supplied with silk-covered cord and attachment plugs. A very handsome and useful Christmas or wedding gift is the panel percolator set, a nine-cup coffee urn of Colonial design with creamer, sugar bowl and tray.

QUESTIONS AND ANSWERS

All Readers Are Invited to Submit Contributions on Electrical Matters to This Department—Answers Should Be Sent Within Eight Days of Date of Publication of Question—Payment Will Be Made for All Answers Published

Questions.

No. 506.—Carrying Capacity of Wires.—Why is it that wiring codes, as a rule, do not allow circuits in houses to be fused heavier than for 10 amperes while giving the capacity of No. 14 wire as 15 amperes? Since No. 14 wire is required by these same codes, it seems that, unless there are other limitations, the circuits could be safely fused for the safe capacity of the wire. If there are other limitations, what are they and how can they be overcome?—J. A. C., Kankakee, Ill.

No. 507.—Armature-Winding Data.—I have a four-pole d-c. motor with an armature 2.5 ft. long by 1.5 ft. in diameter. It is wound with 150 coils and has a resistance of 0.5 ohm, the coils being arranged and connected as a lap winding. Will someone tell me what would be the safe voltage for this machine, and what the field flux should be? Will someone give a formula for finding the voltage of a motor with the resistance of the armature given and with a known flux in the field?—J. G., Chicago.

No. 508.—Burned Laminations in Motor Armature.—I have a 5-hp., 1200-r.p.m., 220-volt d-c. motor the armature of which has been burned out by severe grounding of several coils. This grounding fused together the laminations in sections about 0.5 in. square in four different places. These spots are in different slots and each one affects a different set of laminations. Will it be safe to file out the slots to a smooth finish and rewind the armature, or should I secure new laminations and replace those that have been welded together?—A. L. S., Topeka, Kan.

Answers.

No. 495.—Synchronous Motor as a Condenser.—Will someone please explain for me just how it is that a synchronous motor acts like a condenser? I have read any number of articles on the use of motors as condensers, but have never had a clear explanation given as to how such an effect is produced.—R. H. N., Peoria, Ill.

Answer.—In the Oct. 9 issue of Electrical Review there appeared two answers to Question No. 495, both of which purported to explain why a synchronous motor acts like a condenser, but it may be doubted that the explanations really relieved the inquiring mind of the questioner. The explanation is so simple that it seems to have escaped the notice of writers on the subject who usually resort to vector diagrams or mathematical analysis to establish a proof, to the entire neglect of the following line of physical reasoning:

A synchronous motor, like any other motor whether for direct or alternating current, is subject to the rule that the counter electromotive force must be sensibly equal (numerically) to the impressed voltage, at least within the ordinary range of load. If the impressed voltage is constant, it follows that the counter electromotive force must also be nearly constant within the working range. Now, counter electromotive force is always proportional to the speed and the magnetic flux, and, since the speed is necessarily constant in a synchronous motor, it follows that the magnetic flux must be practically constant to maintain sensibly constant counter electromotive force.

In an alternating-current generator a lagging current exerts a demagnetizing action upon the field, while a leading current exerts a magnetizing action. In an alternating-current motor the action of leading and lagging currents is the exact reverse of the above in accordance with the usual opposite or "mirror-like" relationships between generators and motors. These facts are so well known that proof is not necessary, though simple physical nonmathematical proof is easily possible.

Weakening the excitation of a synchronous motor would of itself tend to weaken the magnetic field of the machine, while strengthening the excitation would tend to build up the flux. But it has been shown above that the magnetic flux must remain sensibly constant. Therefore, since the magnetic flux is set up by the resultant magnetizing action of both field and armature windings, any weakening of field excitation must be compensated by a corresponding increase of armature excitation. This demands a lagging current in accordance with the conditions already stated. Conversely, a strengthening of field excitation demands a reduction of armature magnetizing action and produces a leading current.—A. S. L., St. Louis, Mo.

No. 496.—Meter for Rectified Current.—What kind or type of ammeter should be used to measure accurately the current delivered on the d-c. side of a mercury-arc rectifier?—H. R. G., Houston, Tex.

Answer.—Since the current delivered by a mercury-arc rectifier is a pulsating current, to measure accurately it is necessary to use an ammeter which indicates the effective or root-of-mean-square values of current. The hot-wire and electrodynamometer instruments are of this type.

The measurement of rectifying apparatus is treated in rules 176 to 179 of the Standardization Rules of the American Institute of Electrical Engineers.—H. S. R., Wahpeton, N. D.

No. 501.—Creosote Treatment of Crossarms.—Does the treatment of crossarms with creosote add anything to the safety of a 2300-volt line in case an insulator is broken allowing the bare wire to fall on the arm? Will the treatment of the pole with creosote tend to prevent a leak to ground under similar circumstances? Will the effect be different for higher or lower voltages?—V. N. H., Cedar Rapids, Ia.

Answer.—The dielectric strength of substances of bituminous character is about five times that of dry wood. In addition, a coat of creosote will tend to keep the wood dry and improve the insulating qualities. On the other hand, creosote is highly inflammable, makes line work difficult and, in my opinion, is inferior to paint for general work.—W. H. K., Evanston, Ill.

No. 502.—Suitable Oil for Motors.—We have been having considerable trouble with the heating of bearings on motors operating in a fruit-canning plant. Different grades and mixtures of oil have been used without satisfactory results. Is not a regular motor

oil superior to machine oil for this purpose? Also, is it not common practice to use a heavier-bodied oil for large motors than for smaller ones. I would like to know of a good test for motor oil.—G. L. G., Holcomb, N. Y.

Answer.—To insure satisfactory operating conditions of any machine, a reasonable amount of care must be exercised as to the bearings, the bearing surfaces and the grade of oil which is used on them.

Heavy oils are best suited to the larger types of machines and are not at all suited for machines of the smaller sizes. The grade of oil which offers the best lubricant for these machines is commonly known as "Dynamo" or "Motor" oil. Heavy oils, when used in small motor bearings, do not flow rapidly enough to thoroughly lubricate the surfaces. This results in rapid heating of the bearing and gumming of the oil. Gumming causes the shaft to seize the bearing surface in spots and finally results in the cutting of the shaft and bearing.

It is suggested that all rough or scored shafts be put into good running condition, either by turning up in the lathes or by draw-filing, and then fitted where necessary with new bearings. When reassembled the oil reservoirs should be filled with "Motor" oil and bearing troubles forgotten.—W. F. P., Atlanta, Mass.

Answer.—It is a general rule that heavier motors run at slower speeds than the lighter ones, and slow-speed bearings should be lubricated with heavier oil than the high-speed bearings. It is necessary to use a motor oil rather than a machine oil, and a neutral oil with a viscosity of 200 at a temperature of 70 deg. F. should be suitable to the requirements of this case. The lubricating trouble experienced was caused by using an oil containing acid.

If it is impossible to obtain an acid-free oil that can be depended upon, a simple test can be made as follows: Shake together in a bottle for 30 minutes a small amount of the oil and some water and let the bottle stand for 24 hours. If the oil and water remain together it is evidence of the presence of acid, but if they separate with only a thin white line visible between them the oil is free of acid.—C. McD., Chicago.

No. 504.—Controlling Motor from Two Locations.—I have a 5-hp. induction motor which is started from half-taps on a three-phase transformer bank by means of a three-pole, double-throw switch. Will someone please show how such a motor can be started and stopped from two different locations?—N. W. C., Denver, Colo.

Answer.—The National Electric Light Association specifies that the maximum permissible starting-current values for an installation consisting of a single 220-volt motor shall not be more than 13 amperes per phase per horsepower, for a motor rated at from 2 to 5 hp. For 440-volt motors, 6.5 amperes per phase per horsepower is allowed. It is an unusual case when a 5-hp. three-phase motor cannot be installed to start without the use of an autotransformer to reduce the line voltage and the starting current.

By the use of two three-pole double-throw switches, connected as shown in the accompanying sketch, this motor may be started or stopped by using either switch or may be started by either switch and stopped by the other. Precaution must be taken, however, when stopping the motor not to leave the switch open, but to throw it to the opposite side. For example, suppose switches *A* and *B* are both down and the motor is running. To stop the motor it is only necessary to throw

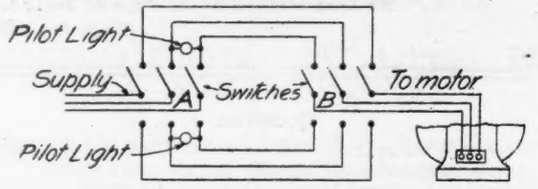


Diagram Showing Method of Operating Motor From Two Points.

either switch, *A* or *B*, up. To start the motor again it is only necessary to throw one switch to the opposite side. If, however, the motor is stopped by leaving either switch open it may be seen from the diagram that it is not possible to start the motor again from the other switch. Pilot lamps should be placed as shown so that one lamp will be lighted whenever the motor is running.—L. M. K., St. Louis.

No. 505.—Energy Required to Heat Water.—I am considering installing an electric water heater in my home and would like to know what amount of energy it will consume. Will someone who has had experience with heaters kindly advise me as to how many kw-hrs. per month are required to heat water for a family of three?

Is a tank heater more economical than an instantaneous faucet heater? Can a tank heater be connected to the ordinary house circuits, or will special connections have to be made?—J. E. R., Chicago.

Answer.—About 25 to 30 gals. of hot water per day at an average temperature of 130 deg. F. is necessary for a family of three for cooking, laundry and bath purposes. This is an average figure which applies where hot water is available at the tap during the full 24 hours of the day, and it will vary considerably with the habits of the family. A 600-watt circulation or plaster-type electric water heater connected to a well-lagged 30 or 40-gal. tank will supply the average requirements of a family of three if on continuously, and would require 430 kw-hrs. per month. The average house circuit would handle a 600-watt heater, but it might be advisable to install special wiring and an extra meter to take advantage of a low cooking or water-heating rate.

A 3000 to 3600-watt circulation electric water-heater on a lagged tank would give approximately the same kind of intermittent hot-water service as can be obtained with the ordinary gas heater. The power input would vary widely with the amount of hot water desired, but probably one hour's use per day would suffice with a use of about 100 kw-hrs. per month. Special wiring and an extra meter would be required for this type of installation.

An instantaneous heater is more efficient than the types using the storage system, but should have a capacity of at least 6000 watts, to give satisfactory results. An intermittent load of 6000 watts in a residence district is usually very undesirable from the standpoint of the central station, since it requires added line and transformer equipment and impairs the voltage regulation on lighting circuits.—R. G. K., Manhattan, Kan.

NEW APPLIANCES

Newly Developed and Improved Electrical and Mechanical Apparatus, Appliances, and Devices Now Being Placed on the Market

Combination Plate for Switch and Receptacle.

A new type of combination switch and receptacle plate, having a removable door, is being manufactured by the

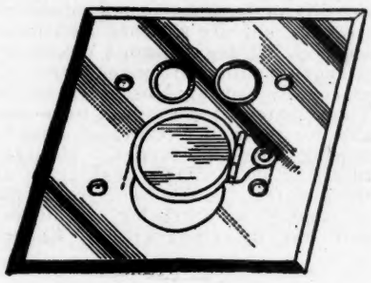


Plate for Switch and Receptacle.

Peerless Light Co., New York City and Chicago. This plate is made to accommodate either the old type, No. 1780, receptacle or the new type of standard flush receptacle.

Electric Burglar Alarm With Master-Key Control.

A burglar-alarm system for the protection of homes, garages, lofts, etc., has recently been put on the market by Paul V. Vandervelde, Corona, N. Y. One of the unique features of the system is the master-key control which permits a person to enter a protected property without sounding the alarm. Such entrance can be made only by a person having a master-key to the system.

Office or Factory Lighting Unit.

H. E. Gleason Co., Seattle, Wash., manufacturer of various types of lighting fixtures, is now marketing a unit known as the "Radiantlite." As may be seen from the illustration, this unit is provided with a silver-plated reflector for directing the light downward. It is also provided with a blown-glass bowl for diffusing the light and producing an even illumination free from glare and shadow. It is said that this unit is practically free from decreased efficiency resulting from accumulation of dust and dirt. A spun-steel shell surrounds and protects the silvered reflector and supports the globe and socket.

Radiantlite Unit for Store, Office and Factory Lighting.

For units in which an ornamental effect is desired, special blown-glass bowls of various designs may be had. These bowls are so designed as to harmonize with various styles of architecture to produce a pleasing and uniform effect.

Hand Lantern Designed to Meet Hard Service.

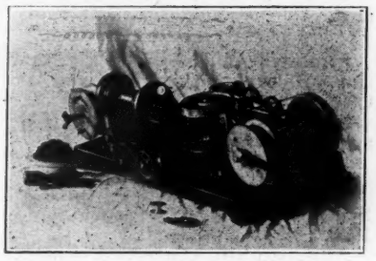
The LaFrance lantern No. 1810, being placed on the market by the American-LaFrance Fire Engine Co., Elmira, N. Y., will appeal to all those who have to carry a light. This lantern is waterproof and is absolutely safe to use around inflammable material of any kind. It is an ideal light for watchmen, firemen, sportsmen or automobilists. All metal parts are of brass and aluminum, accurately machined and nicely finished. The silvered reflector is designed to throw a wide working light with a strong far-reaching beam for smoke, fog, or long-distance work. A focussing device permits of changing the beam while the light is burning.

The light is controlled by a strong snap switch, conveniently located and said to be positively spark proof. The current is supplied by two standard dry cells which will give intermittent service for a considerable time. The finish is regularly in red with black and polished-brass trim, but can be furnished in other colors or in polished aluminum if desired. A bracket for mounting is furnished at a slight extra cost. A plain bracket adapats the lantern for mounting on the wall, truck or boat, and a special heavy brass bracket with a spring lock is used for atachment to fire apparatus.

Device for Winding Tungsten-Wire Filaments.

A machine for automatically winding or concentrating the wire coils used in gas-filled and miniature incandescent lamps of all types has been developed by Charles Eisler, 159 Clifton avenue, Newark, N. J., and is now ready for the market. It is said to be capable of winding coils of from 25 to 900 turns per in. with a core of 0.003 to 0.035 in. in diameter. Wire for lamps from 15 to 1000-watt capacity, and for every size and style of coils, can be handled and any desired spacing between the coils may be obtained.

The wire is wound from a bobbin, over a pulley, and onto a mandrel. Gears, clutches and cams regulate speeds, winding pitch, spacing, etc., to produce a coil of the desired dimensions. Speed of the machine may be varied from 500 to 3000 r.p.m. to suit the size of wire being used. About



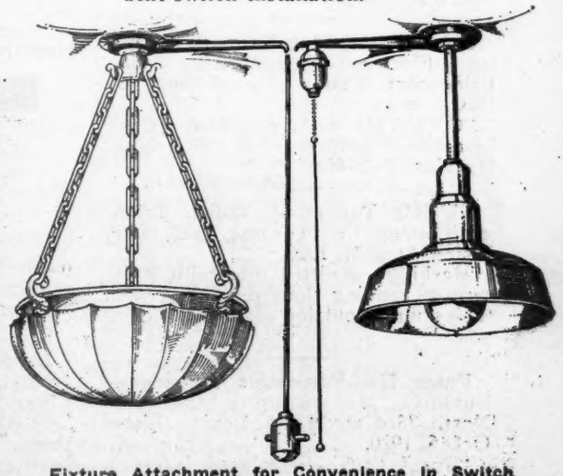
Lamp-Filament Winding Machine.

5000 ft. of small wire may be wound in a single coil. A cherry-red heat is obtained while winding by connecting both ends of the wire to an electrical power circuit and then adjusting the amperage by means of a rheostat placed in series.

Extension Arm for Attachment of Pendent Switch.

The St. Louis Brass Manufacturing Co., St. Louis, Mo., has developed a new product which they will put on the market under the name of the "Brasco Switch Extensions" at an early date. This device is a small arm-like case which extends along the ceiling carrying the wire to the point from which it is attached either to a pendent or pull switch. These switch extensions are made of zinc-plated steel, and have a rust-proof finish.

It is said that the use of switch extensions will result in material savings by the elimination of wiring for wall switches. Also, they provide much better construction than can be had with various other methods of pendent-switch installation.



Fixture Attachment for Convenience in Switch Connection.

LATEST APPROVED APPLIANCES

Approved by Underwriters' Laboratories, Following Examination and Tests Conducted Under the Standards of the National Electrical Code

Armored Cable.—Canadian Triangle Conduit Co., Toronto, Ont., Can. Listed Aug. 27, 1920.

Marking: Armored conductor in form of single strip interlocking armor, with white threads running longitudinally between conductor and armor.

Armored Cable.—Pollack Conduit Co., 467 Greenwich street, New York City. Listed Oct. 5, 1920.

Marking: Letter "P" stamped in armor at interval of about 3 ins.

Autostarters.—General Electric Co., Schenectady, N. Y. Listed Sept. 10, 1920.

Automatically controlled contactors and air-cooled compensators mounted as a unit in metal case, with overload protection and low-voltage protection or release coils; with 2-phase and 3-phase 3-wire installations compensator and motor windings are disconnected from line in off position; with 2-phase, 4-wire installations three wires only are disconnected from compensator and motor windings; with 2-phase and 3-phase, 3-wire installations overhead-release devices in running position operate to open all wires of circuits automatically under overload and therefore may serve as circuit breakers; Type CR-7052.

Conduit Boxes.—Renim Specialty Co., 110 K street, South Boston 27, Mass. Listed Oct. 4, 1920.

"Renim" castiron conduit boxes; catalog Nos. 2X, 3X, 5X, 6X.

Conduit Boxes.—Electric Stamping Co., Hamilton, Ont., Can. Listed Oct. 6, 1920.

Stamped-steel conduit boxes for use with rigid conduit or armored cable; catalog Nos. 54151, 54155 and 54171; covers, catalog Nos. 54C1, 54C2, 54C6, 54C11 and 54C12.

Cutout Bases, Plug-Fuse.—Connecticut Electric Manufacturing Co,. Bridgeport, Conn. Listed Aug. 27, 1920.

"C. E. M. Co." plug-fuse cutout bases; o-30 amperes, 125 volts; catalog Nos. 1945-46.

Flexible Tubing.—Canadian Triangle Conduit Co., Toronto, Ont., Can. Listed Aug. 24, 1920.

Marking: Knitted tube with white thread running longitudinally with tubing under outside covering of compound.

Fuses, Non-Renewable Cartridge.—Bussman Manufacturing Co., 3819 North 23rd street, St. Louis. Listed Oct. 5, 1920.

"Buss" cartridge-inclosed fuses; 0-600 amperes, 250 volts; 0-600 amperes, 600 volts.

Fuses, Plug.—Commercial Enclosed Fuse Co., 1317 Willow avenue, Hoboken, N. J. Listed Oct. 5, 1920.

"Commercial" Edison plug fuses; 0-30 amperes, 125 volts.

Sockets, Medium Base.—Peerless Light Co., Washington boulevard and Union streets, Chicago. Listed Aug. 31, 1920.

"Peerless" Candle Socket.

"Peerless;" keyless candle socket when used with outer casing; catalog No. 3892.

Fuses, Renewable Cartridge.—Chicago Fuse Manufacturing Co., 15th and Laflin streets, Chicago. Listed Sept. 10, 1920.

"Union" cartridge-inclosed fuses; 61-600 amperes, 600 volts.

Fuses, Renewable Plug.—Pierce Fuse Corp., 752 Main street, Buffalo, N. Y. Listed Sept. 21, 1920.

"Pierce" renewable plug fuses; 0-30 amperes, 125 volts; consisting of porcelain casing with screw shell and removable central plug of unglazed porcelain having a central slot for insertion of sheet-metal fusible elements furnished by submittor.

Insulating Links.—Bryant Electric Co., Bridgeport, Conn. Listed Sept. 14, 1920.

"Bryant" or "Perkins"; a device designed to be inserted in chain of pull socket to insulate lower end of chain from upper end; catalog No. 513.

Receptacles, Medium Base.—Peerless Light Co., Washington boulevard and Union street, Chicago. Listed Sept. 7, 1920.

"Peerless;" keyless receptacle with mounting bracket designed for use in

"Peerless" Saddle Socket.

connection with globe and globe-holder to inclose receptacle, lamp and connections; catalog No. 3875.

Insulating Material.—International Insulating Corp., Springfield, Mass. Listed Oct. 17, 1920.

"Black Synthetic" or "Brown Synthetic;" moldable insulating material having the following properties: Slightly absorptive, not strictly noncombustible, good dielectric strength, slightly affected by temperature of 300 deg. C., good mechanical strength, unaffected by acids and oils, practically neutral, readily worked with tools; moldable insulating material having the following properties: Slightly absorptive, somewhat brittle, not strictly noncombustible, good dielectric strength, slightly softened by temperature of 200 deg. C., good mechanical strength, unaffected by acid and oils, practically neutral; Nos. S-1, 3 and 99. These materials are judged to be suitable for parts of electrical devices requiring these properties. Manufacturers of such devices desiring to use these materials should submit samples in commercial form for examination and test by Underwriters' Laboratories.

Switches, Surface—Hart & Hegeman Manufacturing Co., 342 Capitol avenue, Hartford, Conn. Listed July 28, 1920.

"H. & H." two-circuit, catalog Nos. 2547-48, 2635-42 and 2665-80; three-circuit, catalog Nos. 2549-50; heater switches, series, multiple and series-multiple; single-pole, 2 amperes, 250 volts, 5 amperes, 125 volts, catalog Nos. 3781-82, 3789-90 and 3803-04; 5 amperes, 250 volts, 10 amperes, 125 volts, catalog Nos. 3609-12, 3783-84, 3791-92 and 3805-06; 10 amperes, 250 volts, 20 amperes, 125 volts, catalog Nos. 3785-86 and 3793-94; 15 amperes, 250 volts, catalog Nos. 3787-88 and 3797-98; 20 amperes, 250 volts, catalog Nos. 2199-2200, 3795-96, 3799-800, 3809-10 and 3833-36; 30 amperes, 250 volts; catalog Nos. 3801-02 and 3811-12; 10 amperes, 600 volts, catalog Nos. 2193-96.

Switches, Surface—Hart & Hegeman Manufacturing Co., 342 Capitol avenue, Hartford, Conn. Listed July 29, 1920.

"H. & H." single-pole, catalog Nos. 31, 131, 231, 331, 22, 56, 2855-56, 3003 and 3030; double-pole, catalog No. 3334; three-way, catalog Nos. 33, 43, 133, 143 and 3776-77; four-way, catalog Nos. 2091-92 and 2546.

Tubing, Flexible—L. & N. Co., Ltd., St. Johns, Quebec, Can. Listed July 6, 1920.

Marking: White thread parallel with tube between inner lining and paper twine wrapping.

Tubing, Flexible—Short Electric Manufacturing Corp., Penn Yan, N. Y. Listed July 27, 1920.

Marking: "Plia-Duct Penn Yan, N. Y." printed at intervals in interior of lining.

Wires, Flexible Cord—Tubular Woven Fabric Co., Pawtucket, R. I. Listed Aug. 3, 1920.

Marking: One black warp thread in outer covering.

ACTIVITIES IN THE TRADE

Business Developments, Sales Agencies, Trade Literature and Miscellaneous Items Concerning Electrical Manufacturers and Allied Business Interests

Bussmann Manufacturing Co., St. Louis, has issued its catalog No. 11 covering its line of electrical fuses.

Betts & Betts Corp., 511 West 42d street, New York City, manufacturer of electrical specialties, has filed notice of increase in capital from $50,000 to $100,000.

Welland Automobile Storage Battery Co., Cleveland, plans to erect a storage battery plant on a site recently purchased on Weltshire avenue, Toronto, Can.

Thordarson Electric Manufacturing Co., 501 South Jefferson street, Chicago, has issued a folder describing and illustrating the toy transformers which it manufactures.

The Okonite Co., manufacturer of insulated wires and cables, has moved its executive offices to its factory at Passaic, N. J., where all communications should be addressed.

Ideal Electric & Manufacturing Co., Mansfield, O., has removed its Philadelphia offices from 1414 South Penn square to 1131 Race street, where offices and warehouse will be combined.

Westinghouse Electric & Manutacturing Co., 95 Orange street, Newark, N. J., has tentative plans under way for the erection of a three-story addition at its local works, 40 by 115 ft.

Aluminum Co. of America, Pittsburgh, manufacturer of electrical wires and cables, has arranged for a note issue to total $12,000,000, the proceeds to be used for financing, extensions, improvements, etc.

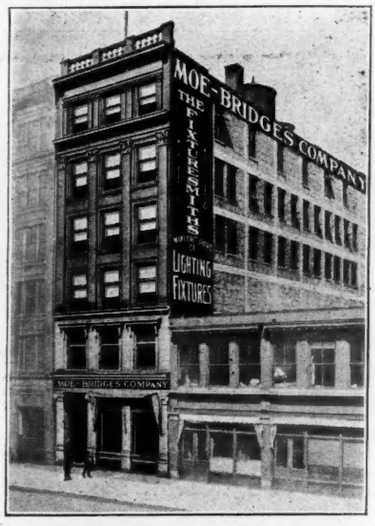
Beardslee Chandelier Manufacturing Co., 216 South Jefferson street, Chicago, has published catalog D-6 on the "Denzar" type of lighting fixtures, which sets forth the mechanical and other features of this particular fixture for illuminating purposes.

National Lamp Works of General Electric Co., Ferry street and Fillmore avenue, Buffalo, N. Y., has made application to the city council for permission to construct its proposed two-story plant building at this location, contract for which was recently awarded. The factory will be 82 by 132 ft., and equipped for the manufacture of light precision equipment used in electric lamp production. If is estimated to cost $120,000.

Duplex Lighting Works of General Electric Co., 6 West 48th street, New York City, has prepared an attractive red and green colored holly-decorative gift certificate for the use of retail customers desiring to give a "Duplexalite" unit as a Christmas present. The certificate bears appropriate holiday greetings and has a space for both the recipient's and donor's name, and announces that the receiver is entitled to the installation of the "Duplexalite" selected. Dealers are being supplied with these certificates imprinted with their names and addresses.

Fairbanks-Morse & Co., Chicago, in bulletin 211-B describes its "H" type of alternating-current, ball-bearing motors. The Fairbanks-Morse starters for squirrel-cage induction motors are outlined in bulletin 203-C.

Moe-Bridges Co., Milwaukee, has issued a complete catalog covering lighting fixtures, glassware and parts manufactured by the company. In addition to illustrating its products, the concern has endeavored through written copy interspersed throughout the book to present certain high spots in its sales talks to aid the dealer in ob-



New Building of Moe-Bridges Co., Milwaukee.

taining a quicker turnover on this line of lighting fixtures. The Moe-Bridges Co. was organized in January, 1919, and the first fixture was turned out on March 28 of the same year. The growth of the company made it necessary to secure larger quarters to keep pace with the demand for its products, and as a result a factory was erected at 236 Broadway, containing over 25,000 sq. ft. of floor space and equipped with the latest types of machinery. Provision has been made for six spacious display rooms, and other modern features of a well-appointed lighting fixture business.

Splitdorf Electrical Co., manufacturer of spark plugs and ignition apparatus with factories in Newark and Camden, N. J., and Sumter, N. C., plans to erect a six-story building, 300 by 120 ft., on West 22nd street, between 54th and 55th avenues, Cicero, Ill. The company has just completed a five-story sales and office building at the southwest corner of Michigan avenue and East 29th street, Chicago. Charles Kratsch, Chicago manager, is to have charge of the new manufacturing plant.

Benjamin Electric Manufacturing Co., Chicago, in the Nov. 1 issue of the "Benjamin Reflector" outlines a window-trimming and experience story contest arranged for dealers handling the Benjamin No. 92 two-way plug. The plan is to stimulate a large holiday sale on this double-socket device.

Westinghouse Merchandising Bureau, 165 Broadway, New York City, has received requests from many of the large cities throughout the country to hold a "Westinghouse Better Merchandising Show" in their territory before the Christmas holidays and it is laying plans to try and fulfill all applications.

General Electric Co., Lynn, Mass., has awarded a contract for the erection of the addition to its local plant, to comprise a one-story structure, 180 by 250 ft., estimated to cost $150,000. The company will hold in abeyance plans for its proposed plant at Springfield, Mass., designed as a five-story structure, 75 by 400 ft., to cost about $500,000.

Cutler-Hammer Manufacturing Co., Milwaukee, in order to include information under one cover on C-H products for mine applications, has prepared a booklet known as publication 836, which illustrates and describes manual and automatic motor controllers, accessory control devices, battery-charging equipment for miners' lamps and for mine locomotives, electric brakes, solenoids, magnetic separators and clutches, electric air heaters and soldering irons. Among the interesting installation views shown are motor-driven mine pumps, hoists and tipple machinery, all controlled by C-H controllers, and lamp batteries and locomotives being charged by C-H charging equipment. The cover of the booklet is in two colors and shows a panoramic view of a mine tipple.

Moore Steam Turbine Corp., Wellsville, N. Y., has issued bulletin No. 24, illustrating and describing its types of turbines, which have been developed to meet a demand for highly efficient units in sizes from 5 to 1000 hp. The policy of the company is to limit the speeds of its larger turbines to 3600 r.p.m. as a maximum, and to obtain the required steam consumption by multi-staging if necessary. By this means the rotation stresses are kept at a low figure, affording a large margin of safety. It is stated that a multi-stage turbine should always be used for condensing service, excepting in the smallest sizes, where perhaps the expense would not be justified. In many cases also and for the same reasons where high steam pressure is used, a multi-stage non-condensing turbine is much superior to a single-stage turbine. The Moore steam turbine has been designed and standardized so the different parts can be manufactured on a quantity production basis.

PERSONAL MENTION

Biographical Sketches and Chronicle of Changes in Business Connections, Promotions and Other Personal News of the Industry

CHARLES H. BAY, formerly appliance manager for the Detroit Edison Co., has become household sales specialist for the Western Electric Co. at Chicago.

A. SCHARF has accepted a position as salesman with the Magnet Appliance Co., Chicago. He was formerly connected with the Peerless Light Co., Chicago.

EDWARD R. DAVENPORT has resigned as sales manager of the Narragansett Electric Lighting Co., Providence, R. I., to represent Bodell & Co. in Dayton, O.

S. W. FRIES has been appointed district sales manager of the Economy Fuse & Manufacturing Co., Chicago, with headquarters at 1205 Commerce building, Kansas City, Mo.

BERT DUNKIN has been appointed acting manager of the Albia Light & Railway Co., Albia, Ia., to succeed Ralph W. Boyer, who has resigned as treasurer and manager to enter another field.

R. L. CLARKE, of the New York City office of H. M. Byllesby & Co., has been appointed assistant general auditor of the Northern States Power Co., with headquarters at Minneapolis, Minn.

O. B. COLDWELL, vice-president of the Portland (Ore.) Railway, Light & Power Co., has been appointed a member of the industrial lighting committee, National Electric Light Association.

W. P. MORGAN, Jr., who was formerly connected with the St. Louis office of the Robbins & Myers Co., has accepted a position in the sales department of the Chandeysson Electric Co., St. Louis.

C. M. HOLLIWELL has been appointed manager of the Windsor (Colo.) office of the Western Light & Power Co., to succeed W. R. Shade, who has been transferred to the Loveland office.

DAVID HAYS has been appointed superintendent of the wiring supplies division at the Bridgeport (Conn.) plant of the General Electric Co. He was formerly connected with the Schenectady factory of the company.

L. M. KLAUBER, who has recently been promoted to general superintendent of the San Diego (Cal.) Consolidated Gas & Electric Co., of which he was previously assistant general superintendent, has been with that company since 1911. He is a graduate of Stanford University in the department of electrical engineering. From 1908 to 1910 he was in the graduate apprentice school of the Westinghouse Electric & Manufacturing Co. at East Pittsburgh, Pa. He is vice-chairman of the overhead systems committee of the National Electric Light Association, a member of the electrical apparatus committee and chairman of the Pacific Coast Engineering Committee.

LEWIS NIXON, public service commissioner for the First New York District since May 3, 1919, recently tendered his resignation in order to devote his attention to his private business interests. He has been succeeded by Alfred M. Barrett, who has acted as deputy commissioner since Mr. Nixon's appointment as commissioner.

J. L. FINNICUM, who has been appointed sales manager of the Thordarson Electric Manufacturing Co., 509 South Jefferson street, Chicago, was connected with the Doubleday-Hill Electric Co., Pittsburgh, for over eight years as salesman, and also had charge of the

J. L. Finnicum.

apparatus department of that company. For the last two years he has been acting as district manager at Chicago for the Electric Products Co., Cleveland.

R. S. MITTEN has been appointed general sales manager of the Electric Appliance Co., 701 West Jackson boulevard, Chicago, to succeed P. R. Boole, who has become affiliated with the Greusel-Quarfot Electric Co., Milwaukee.

PHIL RABON has been appointed sales manager of the Frank Adam Electric Co., St. Louis, to succeed Emil Zinsmeyer, who has resigned to become connected with the Electrical Warehouse Co., Detroit, jobber of electrical supplies.

CHARLES S. HAMMOND, who has been connected with the sales department of the Georgia Railway & Power Co., Atlanta, Ga., for about a year, has resigned and joined the coast artillery corps of the United States army as a lieutenant.

J. W. S. BUTLER has been appointed Pacific Coast representative of Henry L. Doherty & Co., with headquarters in San Francisco. He was formerly vice-president and general manager of the Western States Gas & Electric Co., Stockton, Cal.

L. F. WOOD, who for the past 18 months has been an instructor of technical graduates in the Chicago Central Station Institute, educational bureau of the Commonwealth Edison Co., has accepted an associate professorship in the department of electrical engineering, Iowa State College, Ames.

OBITUARY.

DR. A. H. HOYT, proprietor of the Hoyt Electrical Instrument Works, Concord, N. H., died Oct. 21 at the age of 59 years. He invented a device for measuring electrical current and a timing device for deep sea bombs.

ALEXANDER MACAULEY died in Beverly, Mass., last month, at the age of 56 years. He was born in Souris, Prince Edward Island, Can., and about 32 years ago became connected with the Beverly Gas & Electric Co. At the time of his death he was superintendent of the electrical department, having held that position for the past 15 years.

JAMES MILTON MEANS, who had been connected with the Georgia Railway & Light Co., Atlanta, Ga., for many years, died last month. He entered the service of the company in June, 1895, as a conductor and had worked his way up through various positions, being assistant superintendent of transportation at the time of his death, which position he had held since the early part of 1919.

PROF. JOHN R. ALLEN, well known scientist and director of the research bureau, American Society of Heating and Ventilating Engineers, died Oct. 28 at his home in Pittsburgh. He was born in Milwaukee, July 23, 1869, and received his preparatory education in that city and at the Ann Arbor (Mich.) high school. In 1892 he graduated from the University of Michigan with the degree of bachelor of science in mechanical engineering and received his master's degree from the same institution four years later. During two of these years he was connected with the L. K. Comstock Construction Co. He was head of the mechanical engineering department of the University of Michigan from 1913-1917, and the following two years was dean of the college of engineering and architecture, University of Minnesota, leaving there to assume the duties of director of the research bureau, American Society of Heating and Ventilating Engineers, which position he held at the time of his death. Professor Allen was a past-president of the American Society of Heating and Ventilating Engineers and the Michigan Engineering Society and a member of the American Society of Mechanical Engineers and other technical organizations.

BUSINESS OPPORTUNITIES

News of Electrical Construction Projects in All Parts of the Country, Proposals Invited, Foreign Trade Openings and New Companies

EASTERN STATES.

Rutland, Vt.—The New England Table & Manufacturing Co., is considering plans for the erection of a one-story power house to be used in connection with extensions to its factory on Strong avenue.

Rutland, Vt.—Electric motors, electric-operated machinery and other electrical apparatus will be installed in the one-story mill building now being erected by the Vermont Marble Co., at West Rutland, to be 140 by 157 ft. Contract for furnishing power has been awarded to the Vermont Hydroelectric Corp.

Boston, Mass.—The Edison Electric Illuminating Co. has construction under way on a one-story substation in the Hyde Park district, to serve this territory for commercial work. The company has had plans prepared for alterations and improvements in its building at 1165 Massachusetts avenue, to cost about $30,000.

Boston, Mass.—The A. T. Stearns Lumber Co., 99 Taylor street, is having plans prepared for improvements in its power plant to cost about $30,000. Monks & Johnson, Boston, are the architects.

Fall River, Mass.—The Lincoln Manufacturing Co. will build a one-story switching station at its local textile mills, in connection with the erection of a three-story addition to mill No. 2, to cost about $300,000.

Fall River, Mass.—The Osborne Mills, manufacturer of textile products, has commenced the construction of a transformer house on Montaup street, to cost about $15,000. The building contract has been let to Beattie & Cornell, 35 North Quarry street.

Springfield, Mass.—The Hampshire Paper Co., South Hadley Falls, near Springfield, has awarded a contract to the Samuel M. Green Co., 293 Bridge street, Springfield, for extensions and improvements in its power plant.

Hartford, Conn.—The Royal Typewriter Co. has awarded a contract to the Collins-Lotz Co., 60 Prospect street, for alterations and extensions in its power plant for increased service.

Middletown, Conn.—The Goodyear Rubber Co. has work under way on a power plant at its local factory.

New Haven, Conn.—The United Illuminating Co., Broad street, Bridgeport, Conn., has construction work well under way on its power plant on Pembroke street, New Haven, estimated to cost $300,000, including machinery.

Buffalo, N. Y.—The Niagara Falls Power Co. is planning the construction of a transmission line between Niagara Falls and Buffalo, by way of Grand Island. The new line will be constructed with less mileage than the existing high-tension system between these points and will furnish a total of about 100,000 hp. in excess of present service. The company will also furnish light and power for local distribution on Grand Island.

Hornellsville, N. Y. — The Public Service Commission has granted permission to the Hornell Electric Co. to construct and operate a power plant at Hornellsville, for local light, heat and power service.

New Lebanon, N. Y.—The New Lebanon Electric Light & Power Co. has been incorporated with a capital of $15,000 to operate an electric light and power system in Rensselaer county. The incorporators are W. Fowler, R. B. Whitegiver and R. H. Gillett.

New York, N. Y.—The New York Telephone Co. is planning to expend about $33,000,000 for extensions and improvements in this district during the coming year. It is proposed to secure 14 new sites for exchanges and other buildings, and to make extensions to 16 existing exchange plants.

New York, N. Y.—Transit Construction Commissioner John H. Delaney, has plans under way for the proposed new subway traction system, to include a total of 21 additional two-track tunnels, with complete third rail electric service, etc., connecting all boroughs of the Greater City. The entire project is estimated to cost $350,000,000. Daniel L. Turner is chief engineer for the commission.

New York, N. Y.—The New York Edison Co., 55 Duane street, has plans well under way for the erection of its proposed electric generating plant in the Port Morris section. The new station will cover a portion of the site bounded by Locust avenue and the East river, 132d and 134th street, aggregating 450 by 535 ft., and is estimated to cost approximatelv $5,500,000.

North Tonawanda, N. Y.—Fire Oct. 31 at the local plant of the Niagara Falls Power Co., caused by an explosion due to a new installation, resulted in a property loss estimated at $80,000. The company has arranged for the installation of a new bank of 45,000-volt transformers at its local substation, to provide an additional operating capacity of about 10,000 hp., or approximately double the present output. The present transformers are of 22,000-volt rating.

Troy, N. Y.—The Ford Motor Co., Detroit, has commissioned Stone & Webster, 147 Milk street, Boston, to prepare plans for its proposed tractor manufacturing plant at Green Island, near Troy. The work will include a hydroelectric power plant for general works service. Application recently was made to the Federal Water Commission, Washington, D. C., for permission to utilize waters in this district for the generating station. Bids for construction will be taken at an early date.

Utica, N. Y.—The State Hospital Commission, Albany, has awarded a contract to Mack & Mack, 103 Park avenue, New York City, for the installation of electric equipment and underground service work at the State Hospital, Utica. The work will cost about $23,500.

West New Brighton, N. Y.—The Department of Public Welfare, Municipal Building, New York City, has had plans prepared for the erection of a power plant at the Sea View Hospital, West New Brighton, to cost about $50,000.

Atlantic City, N. J.—The State Highway Commission has approved the application of the Atlantic City Electric Co. for permission to build a transmission line on part of the state highway system, between Absecon and Tuckerton. The new line will operate at 22,000 volts, and will be used for service to the new radio plant in this section of the Radio Corp. of America, Woolworth building, New York City.

Bayonne, N. J.—The Texas Co., Rabineau street, has construction under way on a power house addition at its local oil works, to cost about $15,000.

Newark, N. J.—Plans have been filed by the board of education for the erection of an electrical plant in connection with the vocational school to be built at Sussex avenue, Jay and First streets, at an estimated cost of $1,050,000.

Newark, N. J.—At the general election Nov. 2 citizens approved a referendum providing for the construction of a municipal electric light and power plant, to be operated in conjunction with the city waterworks. The project is estimated to cost $15,000.000. The department of streets and public improvements will handle the preliminary work.

Phillipsburg, N. J.—The common council, in company with the local board of trade, has preliminary plans under way for the establishment of a municipal lighting plant. John Perdoe and E. J. Brooks are members of a committee appointed by Mayor Smith to develop details and estimates of cost.

Plainfield, N. J.—Considerable electrical and mechanical equipment will be installed in the incinerating plant to be constructed by the city at a cost of about $38,000.

Succasunna, N. J.—The Board of Public Utility Commissioners has handed down a decision in a petition brought by the authorities of Roxbury township, Morris county, to compel the New Jersey Power & Light Co., Dover, to extend its lines on Hillside avenue for street-lighting service. With a resident refusing the company permission to place poles on her property, the board says that the Township Commissioners should designate

the location for the new poles, in which event the company agrees to install. The installation of the new system will proceed at once.

West Orange, N. J.—Thomas A. Edison, Inc., has awarded a contract to the American Concrete Steel Co., 27 Clinton street, Newark, N. J., for a one-story turbine building for its power department, to cost about $40,000.

Harrisburg, Pa.—The Public Service Commission has approved the merger of eight electric companies operating in Berks, Lebanon and neighboring counties into the Blue Mountain Electric Co., with headquarters at Bethel, capitalized at $50,000. The companies affected are the Blue Mountain, Bunker Hill, Bethel Township, Marion, Union Township, Mt. Aetna, Upper Bern and Upper Tulpehocken Electric companies. Isaac B. Klinger is treasurer of the new company.

Harrisburg, Pa.—The Harrisburg Light & Power Co. has filed plans for the erection of a one-story addition to its electric station on Cedar street, near West Cameron street. The extension will be used for increased power service in this district. The city council is negotiating with the company for better service and has adopted resolutions asking the utility to eliminate all non-essential consumption until its plant is made adequate for present load conditions, and further, for a statement of all outside sources where electric energy can be secured by the city for local distribution. Electric signs have been discontinued temporarily on account of power shortage.

Johnstown, Pa.—The Union Public Service Co. has been organized with a capital of $5000 to operate a local light and power system. L. B. Saylor, Johnstown, is treasurer.

McAlisterville, Pa.—The McAlisterville Electric Light Co. has been incorporated with a capital of $5000 to operate a local light and power system. I. G. Headings, treasurer.

Marklesburg, Pa.—The Marklesburg Electric Light & Power Co. has been incorporated with a capital of $6000 to operate a local electric light and power system. F. G. Brumbaugh is treasurer.

Philadelphia, Pa.—Bids have been received by the officer in charge of construction at Frankford Arsenal, for the installation of an electric lighting system in the new power plant building.

Philadelphia, Pa.—Electrical and mechanical equipment will be installed in the ice plant and storage building to be erected by the American Ice Co. on its property at Tenth and Callowhill streets.

Philadelphia, Pa.—The Bell Telephone Co. of Pennsylvania, 1631 Arch street, has called a special meeting of stockholders Dec. 9, to approve a security issue of $150,000,000, the proceeds to be used in part for station and line extensions and betterments in different parts of the state.

Philadelphia, Pa.—The Philadelphia Electric Co. has tendered a proposal to the city for the lighting of public highways and streets during the coming year at a price of $1,355,868, including the installation of proposed new street lamps. The contract for the present year, 1920, was placed at $1,317,289. The entire excess, it is stated, will be for the new lighting units.

Philadelphia, Pa.—The Harbison Dairies, Inc., will build a one-story power house to cost about $40,000 in connection with its new plant at Hunting Park and Torresdale avenues. Headquarters of the company are at Front and Diamond streets.

Sunbury, Pa.—The Pennsylvania Power & Light Co. has made application to the Public Service Commission for permission to merge three electric companies operating in Northumberland county with its organization, combining plants and systems.

Tyrone, Pa.—The borough officials are conferring with the Public Service Commission for improvements and betterments in the local street lighting system and service.

York Haven, Pa.—Low water conditions have compelled the York Haven Water & Power Co. to curtail its plant operation, utilizing but 13 of the 20 generating units at the power plant Service to a number of industrial interests, including the Bethlehem Steel Co., has been reduced.

Baltimore, Md.—The Standard Oil Co. has construction under way on a transformer house at its property on Second avenue, near First avenue.

Baltimore, Md.—The General Chemical Co., Munsey building has had plans prepared for the erection of a power house, 50 by 59 ft., at its plant at Race and Winder streets.

Baltimore, Md.—Electrical and mechanical equipment will be installed in the school to be erected by the board of education at Latrobe Park. Plans for the structure have just been completed, and bids will be asked at once. It is estimated to cost in excess of $600,000.

Baltimore, Md.—Considerable electrical and mechanical equipment will be installed in the new $100,000 plant of the Baltimore Pearl Hominy Co., to be located at the foot of Howard street.

Roanoke, Va.—The proposed electric power plant to be erected by the Norfolk & Western Railway Co. in this city is estimated to cost $300,000.

Huntington, W. Va.—The Mountain State Coal Co. has plans under way for the erection of a one-story electric power plant at its coal properties at Ritter, W. Va. C. T. Benton is president; G. E. Gary, consulting engineer.

Parkersburg, W. Va.—The Monongahela Valley Traction Co. plans to double the capacity of its power plant by improvements and additions to the machinery and equipment, including a 5000-kw. turbine.

Wilmington, N. C.—Fire Oct. 31 destroyed the power plant and other departments at the works of the Widemer Lumber Co., with a loss estimated at $100,000.

Greer, S. C.—The Piedmont & Northern Railway Co. has arranged for the construction of a local substation to cost about $3000. Address A. D. Fry, agent.

Graniteville, Ga.—The Graniteville substation of the Augusta-Aiken Railway & Electric Corp., was destroyed by fire recently with a loss estimated at $20,000.

Pineora, Ga.—The Pineora Utilities Co., recently organized, is planning the installation of a local electric lighting plant. A telephone system will also be installed.

Reynolds, Ga.—The common council has plans under way for the installation of an electric lighting system. Address E. E. Hodges, mayor.

Apalachicola, Fla.—The city council has approved a bond issue of $50,000 for the installation of a municipal electric light and power plant, which will comprise generating apparatus, engine and auxiliary equipment. Address J. H. Cook, mayor.

Tampa, Fla.—The Tampa Electric Co. was instructed to cut out certain arc lights and install incandescents on various streets.

NORTH CENTRAL STATES.

Columbus, O.—The board of directors of the Long Street Improvement Association will confer with members of the city council on the proposed extension of ten-cluster lighting system as far as 20th street. Address L. Hughes, chairman.

Easton, O.—A franchise has been granted by the county commissioners to W. T. McCabe to erect and maintain an electrical transmission line in Preble county.

Hamilton, O.—A contract was awarded the F. Bissell Co., Toledo, for covered cables and electric wire for residential underground system.

Huron, O.—The Brook Light & Power Co. has been authorized by the county commissioners to extend its electric lines south of Huron.

Oakwood, O.—The council is discussing ways and means to substitute electricity for gas street lighting.

Mt. Clemens, Mich.—A petition has been presented by the city council for installing a boulevard lighting system on Walnut and Macomb streets.

St. Joseph, Mich.—The city will install a modern curb lighting system next spring. Address Ray W. Davis, secretary of the chamber of commerce.

Indianapolis, Ind.—The Commissioners of Marion County plan to install electric lighting fixtures in all county institutions.

Chicago, Ill.—The Waltham Motors Corp., 401 North Hoyne avenue, plans to erect a one-story power plant and factory building.

Lincoln, Ill.—The Lincoln Water & Light Co. plans to make improvements to its plant at an estimated cost of $60,000. A 650-kw. General Electric turbogenerator will be installed.

Springfield, Ill.—Plans for restoring the Fourth street lighting program to the pre-war schedule will be discussed by the local chamber of commerce. The city council will be asked to increase the present appropriation to meet the additional cost involved through operation of the lighting system at full power.

De Pere, Wis.—The De Pere Light & Power Co. has been re-organized and its capital increased to $150,000. Additional money will be used in improvements and expansion. Address L. L. Tessier, superintendent.

Pardeeville, Wis.—The Pardeeville Electric Co. has been incorporated with a capital of $25,000 to erect an electric light and power plant. The incorporators are John J. Wright, H. A. Figor and Joseph Chandler.

Waupaca, Wis. — The Waupaca Electric Service & Railway Co. has increased its capital from $50,000 to $100,000 for the purpose of making improvements and extensions to its plant.

Duluth, Minn.—Lights will be installed 105 ft. south of Fifth street on Woodland avenue at the corner of 47th avenue West and Sixth street. The Duluth Edison Electric Co. will handle the work and furnish the service.

St. Cloud, Minn.—A contract was awarded the Ray Electric Light Co. for an electric light plant at the county home.

St. Paul, Minn.—Plans are being made by the Diocese of St. Paul to construct a power house at the College of St. Thomas, Merriam Park.

Swift Falls, Minn.—The Swift Falls Mercantile Co. is investigating the advisability of establishing an electric power plant here with the intention of supplying nearby villages with electric service.

Havelock, Ia.—The South Electric Line has been incorporated with a capital of $1000. Address C. E. Speer, president.

Iowa Falls, Ia.—The Hardin Township Electric Co. has been incorporated with a capital of $5000. Address E. L. Killing, president.

Mexico, Mo.—The Missouri Utilities Co. is planning the erection of additions to its plant for increased capacity. Improvements and extensions in transmission lines and distributing system are also planned. The company has recently increased its capital to $1,000,000.

St. Louis, Mo.—The Board of Public Service has had plans prepared for the erection of a one-story addition to its power house, 65 by 80 ft. E. R. Kinney is president.

Volga, S. D.—The electric light plant formerly owned by O. M. Olson will be taken over by the city council.

SOUTH CENTRAL STATES.

Louisville, Ky.—The board of park commissioners is planning the installation of a lighting system in Central Park, to cost about $13,000. M. H. Crawford is president of the board.

Paducah, Ky.—The plant of the Home Electric Power & Supply Co. was damaged by fire recently. The loss is estimated at $30,000.

Martin, Tenn.—A bond issue of $150,000 has been voted to construct electric light and water plants. Address the mayor.

Oxford, Miss.—The common council has arranged a bond issue of $30,000 for improvements in the local electric power plant and municipal waterworks.

Pascagoula, Miss.—The city council has approved a bond issue of $25,000 for the installation of an electric lighting system, in conjunction with municipal waterworks.

Winona, Miss.—The city council is planning the purchase of the local electric plant, including affiliated utilities, for municipal operation. A bond issue of $60,000 will be provided for the acquisition.

Cyril, Okla.—The Cyril Light Co. is planning the rebuilding of its power plant recently damaged by fire.

Amarillo, Tex.—The City Light & Water Co. is planning extensions and improvements in its electric power plant and waterworks system to cost about $100,000.

Breckwalker, Tex.—The Oil Belt Power Co. is planning the construction of a number of distributing lines to serve the different oil properties in this section. A local transformer station will be constructed. Headquarters of the company are at Eastland, Tex.

WESTERN STATES.

Salt Lake City, Utah.—The Utah Power & Light Co. has been granted permission by the Public Utilities Commission to extend its lines to Millville and in Juab county.

Ilwaco, Wash.—The city contemplates purchasing the distribution system of the North Shore Light & Power Co., and the installation of a 1000-kw. generating plant. Address E. E. Wood, manager.

Klamath Falls, Ore.—Plans are being made by the California-Oregon Power Co. to increase the power development at the Prospect plant.

Hollywood, Cal.—The Hollywood board of trade is completing final details for its plan to install a street lighting system to cover the entire Hollywood section. The cost is estimated at $1,500,000.

Sacramento, Cal. — The United States Electric Steel Production Co., San Francisco, plans to erect a hydroelectric plant in Sacramento at a cost of $5,000,000. The proposed plant would develop 100,000 hp.. Address Sacramento Chamber of Commerce.

Stockton, Cal.—Frank B. Pattee, Oakdale, Cal., and Samuel Bernhard, San Francisco, have applied for water rights on the Stanislaus river in Tuolumne county, for the purpose of erecting a power plant to develop about 9600 hp. The estimated cost of the project is $2,000,000.

Sunnyvale, Cal.—The Federal Radio Telegraph Co. is planning to erect a radio tower near Sunnyvale at a cost of $200,000.

CANADA.

Morden, Man.—The Manitoba hydroelectric system is to be extended 51 miles. Address J. M. Leamy, provincial power commissioner.

INCORPORATIONS.

Chicago, Ill.—Battery Specialty Co. Capital, $5000. To manufacture batteries, etc. Incorporators: Carl Behn, Jr., 6417 Sheridan road, Chicago, John McGlashan and others.

Los Angeles, Cal.—Pacific Lighting Fixture Co. To manufacture electric fixtures, etc. Incorporators: William F. Brandes, 3035 West Pico street, and others.

Toronto, Ont.—Canadian Edison Appliance Co., Ltd. Capital, $525,000. To manufacture electrical specialties, etc. Incorporators: George E. Atwood, William A. J. Case and James B. Taylor.

Toronto, Can.—Ross Electric Appliances, Ltd. Capital, $40,000. To manufacture electrical supplies, motors, machinery, etc. Incorporators: John H. Ross, Charles A. Barron, 268 Sherburne street, Toronto, and others.

Montreal, Que.—Canadian Electrical Corp., Ltd. Capital, $1,000,000. To manufacture electric railway apparatus, etc. Incorporators: Ronald B. Sutherland, L. Genest and others.

Buffalo, N. Y.—Liske-Wagner Co. Capital, $15,000. To manufacture motors, etc. Incorporators: C. Liske, A. E. Wagner and W. C. Shields.

Jersey City, N. J.—H. B. Polak Manufacturing Co. To manufacture electrical equipment. Incorporators: Henry B. Polak, 279 Magnolia avenue, Jersey City, and others.

Jersey City, N. J.—Live Wire Electrical Appliances Co. Incorporators: Edward Mahlen, 181 Griffith street, Jersey City, and others.

Cleveland, O. — First National Lighting Corp. Capital, $100,000. To manufacture commercial and industrial electric lighting fixtures. Incorporators: President, Joseph L. Jaffe; vice-president, William S. Kiesel; secretary-treasurer, C. H. Heide, 2030 East 22d street, Cleveland.

Dallas, Tex.—Martin Wright Electric Co. Capital, $20,000. Incorporators: Martin Wright, L. B. French and E. B. Zoller.

Alderson, W. Va.—Alderson Electric Appliance Co. Capital, $10,000. Incorporators: R. B. Beadles and L. E. Collins.

Wilmington, Del.—Rubin Engineering Corp. Capital, $100,000. To manufacture electrical appliances, etc. Incorporators: E. M. Macfarland, Philadelphia; F. R. Hansell and J. V. Piurm.

Wilmington, Del.—Goodwear Storage Battery Co. Capital, $100,000. To manufacture electric storage batteries. Incorporators: M. A. Bruce, T. L. Croteau and S. E. Dill.

Hagerstown, Md.—Alfco Electric Co. Capital, $10,000. To manufacture electric fixtures and appliances. Incorporators: Frank A. and G. E. Vogelsang, and Ambrose L. Foreman.

Passaic, N. J.—Ajax Battery Co. Capital, $500,000. To manufacture electric storage batteries. Incorporators: Delos C. Gibson, J. H. Lefferts and Richard Baker, Garfield.

Bridgeton, N. J.—Lyons Electric Appliance Co. Capital, $100,000. To manufacture electrical apparatus. Incorporators: John P. Lyons, R. E. Shoemaker and Frank Bacon.

Union, N. J.—International Incandescent Lamp Works. Capital, $100,000. To manufacture electric lamps. Incorporators: Conrad Schickerling, A. W. Schaad and L. E. Schickerling.

Utica, N. Y.—Worden Electric Co. Capital, $10,000. To manufacture electrical apparatus. Incorporators: B. C. Madden, S. A. Hagan, and L. E. Worden, Whitesboro.

Mt. Vernon, N. Y.—Lighting Supply Co. Capital, $10,000. To manufacture electrical equipment. Incorporators: E. Miller, S. Ossroff and A. Harris.

FINANCIAL NEWS

Comment on the Financial Outlook in the Electrical Industry, New Securities, Reports of Earnings, Dividends and Utility Stocks

Offering of Edison Electric Appliance Co. Bonds.

The First Trust and Savings Bank and the National City Bank of Chicago are offering at 98 and interest, yielding over 7.9%, $500,000 first mortgage three-year 7% gold bonds of the Edison Electric Appliance Co. The proceeds of the sale of these bonds will be used in part to pay temporary loans incurred in the construction of additional manufacturing facilities and to provide further plant and inventory extensions required to complete business now on hand. The earnings of the company for 1919, after allowing for federal taxes, but before interest deductions, were $373,458, or over three and one-half times the interest requirements of the entire issue. For the first eight months of the present year the net profit of the company before interest or taxes was over six and one-half times the interest requirements of the total issue for the entire year.

Bond Offering of Arkansas Valley, Railway, Light & Power Co.

A new issue of $1,400,000 first and refunding mortgage 7.5% sinking fund gold bonds, dated Nov. 1, 1920, and due Nov. 1, 1931, of the Arkansas Valley Railway, Light & Power Co. (Colorado) is being offered at 96 and accrued interest, to yield over 8%, by H. M. Byllesby & Co. and the Federal Securities Corp. The proceeds of this issue with other funds will be used to retire underlying bonds and other maturing obligations and for extensions and improvements to the properties.

Eight Months' Showing of Pacific Gas & Electric Co.

A statement of the earnings of the Pacific Gas & Electric Co. for the eight months ended Aug. 31, 1920, shows a net of $6,817,629, against $6,120,074 for the corresponding period in 1919. The balance available for common dividends amounted to $1,855,137, equal to $5.45 a share on the $34,004,058 of common stock outstanding, compared with $2,355,605 for the same period last year. The gross earnings for the eight months established a new high record for any similar period, the amount being $22,705,763, against $17,250,412 for the same period in 1919.

Idaho Power Co.

	1920.	1919.
August gross	$ 231,509	$ 172,280
Net after taxes	129,559	95,575
Total income	138,728	103,092
Surplus after charges	89,559	60,921
12 months' gross	2,157,713	1,667,651
Net after taxes	1,114,869	787,379
Total income	1,201,789	837,087
Surplus after charges	716,964	383,674
Balance after preferred dividends	638,711	325,613

Cumberland County Power & Light Co.

	1920.	1919.
August gross	$ 303,376	$ 273,357
Net after taxes	122,171	104,918
Surplus after charges	66,498	49,176
12 months' gross	3,022,361	2,886,172
Net after taxes	1,039,681	846,122
Surplus after charges	372,473	109,687

Columbia Gas & Electric Co.

	1920.	1919.
September gross	$1,084,100	$ 876,731
Net after taxes	726,894	571,116
Surplus after charges	302,619	165,743
Nine months' gross	10,588,016	8,585,845
Net after taxes	7,286,968	5,710,745
Surplus after charges	2,516,699	2,225,230

Earnings of Northern States Power Co.

There was an increase of $179,264 in the gross earnings and an increase of $1759 in the net earnings of the Northern States Power Co. for September, 1920, compared with the corresponding month in 1919. The net increase compares with a net decrease in August of $41,919 (under August, 1919), due to increased coal costs which have been partially offset by increased rates effective Sept. 1 in several of the cities served by the company. Gross earnings for the year ended Sept. 30, 1920, were $11,094,479, compared with $9,477,907 for the previous year. The net for the year ended Sept. 30, 1920, was $4,324,531, an increase of $270,711 over the corresponding period in 1919.

Virginia Railway & Power Co.

	1920.	1919.
September gross	$ 936,654	$ 770,151
Net earnings	224,620	261,945
Total income	237,097	277,072
Surplus after charges	42,274	94,706
Three months' gross	2,754,425	2,293,197
Net earnings	693,184	781,638
Total income	732,176	825,108
Surplus after charges	141,193	278,924

Consumers Power Co., Including Michigan Light Co.

	1920.	1919.
August gross	$1,168,063	$ 905,752
Net earnings	343,747	336,126
Surplus after fixed charges	87,429	131,983
Balance after preferred dividends	22,847	67,711
12 months' gross	13,336,937	10,670,399
Net earnings	5,087,686	4,769,499
Surplus after fixed charges	2,296,094	2,168,840
Balance after preferred dividends	1,522,819	1,399,517

Manila Electric Railroad & Lighting Corp.

	1920.	1919.
September gross	$ 280,312	$ 220,743
Net after taxes	94,296	56,261
Surplus after charges	62,505	28,587
12 months' gross	3,222,028	2,493,925
Net after taxes	1,033,519	905,340
Surplus after charges	651,427	597,779
Balance after dividends	351,427	297,779

Utah Power & Light Co. and Subsidiary.

	1920.	1919.
September gross	$ 536,876	$ 472,753
Net after taxes	234,266	210,473
Total income	247,977	220,088
Surplus after charges	104,504	84,543
12 months' gross	6,348,823	5,590,522
Net after taxes	2,921,019	2,837,059
Total income	3,061,380	2,977,263
Surplus after charges	1,381,951	1,264,833
Balance after preferred dividends	790,451	707,025

Detroit Edison Co. and Subsidiaries.

	1920.	1919.
September gross	$1,801,269	$1,302,229
Net earnings	306,779	277,151
Surplus after charges	81,644	127,728
Nine months' gross	15,474,217	11,591,529
Net earnings	2,768,472	2,998,712
Surplus after charges	1,038,202	1,739,431

Montana Power Co.

	1920.	1919.
Three months' gross	$1,908,679	$1,492,322
Net after taxes	1,198,499	940,518
Surplus after charges	*757,198	*487,316
Nine months' gross	5,982,424	5,073,490
Net after taxes	3,952,156	3,266,679
Surplus after charges	*2,636,541	*1,910,032

*Before depreciation. Item for full 1919 year amounted to $300,000.

Dividends.

	Term.	Rate.	Payable.
Cities Serv. bnkrs	M	43.5c	Dec. 1
Cent. Ark. Ry. & Lt. pf.	Q	1.75%	Dec. 1
Kaministiquia PowerCo.	Q	2%	Nov. 15
Keokuk Elec. pf.	Q	$1.50	Nov. 15
Key West Elect. pf.	Q	$1.50	Dec. 1
Montreal Lt., Ht. & Pr. Cons.	Q	1.75%	Nov. 15
Montreal Lt., Ht. & Pr.	Q	2%	Nov. 15
Nor. Tex. Elec.	Q	$2	Dec. 1
West Penn. Tr. & Wat. Pr. pf.	Q	1.5%	Nov. 15
J. G. White, Inc., pf.	Q	1.5%	Dec. 1
J. G. White Mangt. pf.	Q	$1.75	Dec. 1
J. G. White Eng. com.	Q	1.5%	Dec. 1

WEEKLY COMPARISONS OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities—	Div. rate. Per cent.	Bid Nov. 3.	Bid Nov. 9.
Adirondack Electric Power of Glens Falls, common	6	14	14
Adirondack Electric Power of Glens Falls, preferred	6	72	71
American Gas & Electric of New York, common	10+extra	106	105
American Gas & Electric of New York, preferred	6	37	35
American Light & Traction of New York, common	..	110	115
American Light & Traction of New York, preferred	6	81	81
American Power & Light of New York, common	4	54	55
American Power & Light of New York, preferred	6	64	62
American Public Utilities of Grand Rapids, common	..	9	7
American Public Utilities of Grand Rapids, preferred	7	21	20
American Telephone & Telegraph of New York	..	100	100
American Water Works & Elec. of New York, common	..	3	3
American Water Works & Elec. of New York, particip	7	7	6½
American Water Works & Elec. of New York, 1st preferred	..	47	46
Appalachian Power, common	..	4	2
Appalachian Power, preferred	7	18	17
Cities Service of New York, common	+extra	308	305
Cities Service of New York, preferred	6	65	65
Commonwealth Edison of Chicago	8	103	102
Comm. Power, Railway & Light of Jackson, common	..	18	17
Comm. Power, Railway & Light of Jackson, preferred	6	42	37
Federal Light & Traction of New York, common	..	8	7
Federal Light & Traction of New York, preferred	..	46	46
Northern States Power of Chicago, common	..	44	45
Northern States Power of Chicago, preferred	ex.div.7	78½	79
Pacific Gas & Electric of San Francisco, common	..	55	53
Public Service of Northern Illinois, Chicago, common	7	65	65
Public Service of Northern Illinois, Chicago, preferred	6	85	85
Standard Gas & Electric of Chicago, common	..	16	16
Standard Gas & Electric of Chicago, preferred	8	37	37
Tennessee Railway, Light & Power of Chattanooga, common	..	1½	1
Tennessee Railway, Light & Power of Chattanooga, preferred	6	4	4
Western Power of San Francisco, common	..	22	21
Western Union Telegraph of New York	extra	92	92
Industrials—			
Electric Storage Battery of Philadelphia, common	4	120	121
General Electric of Schenectady	8	139	138
Westinghouse Electric & Mfg. of Pittsburgh, common	7	48	47½